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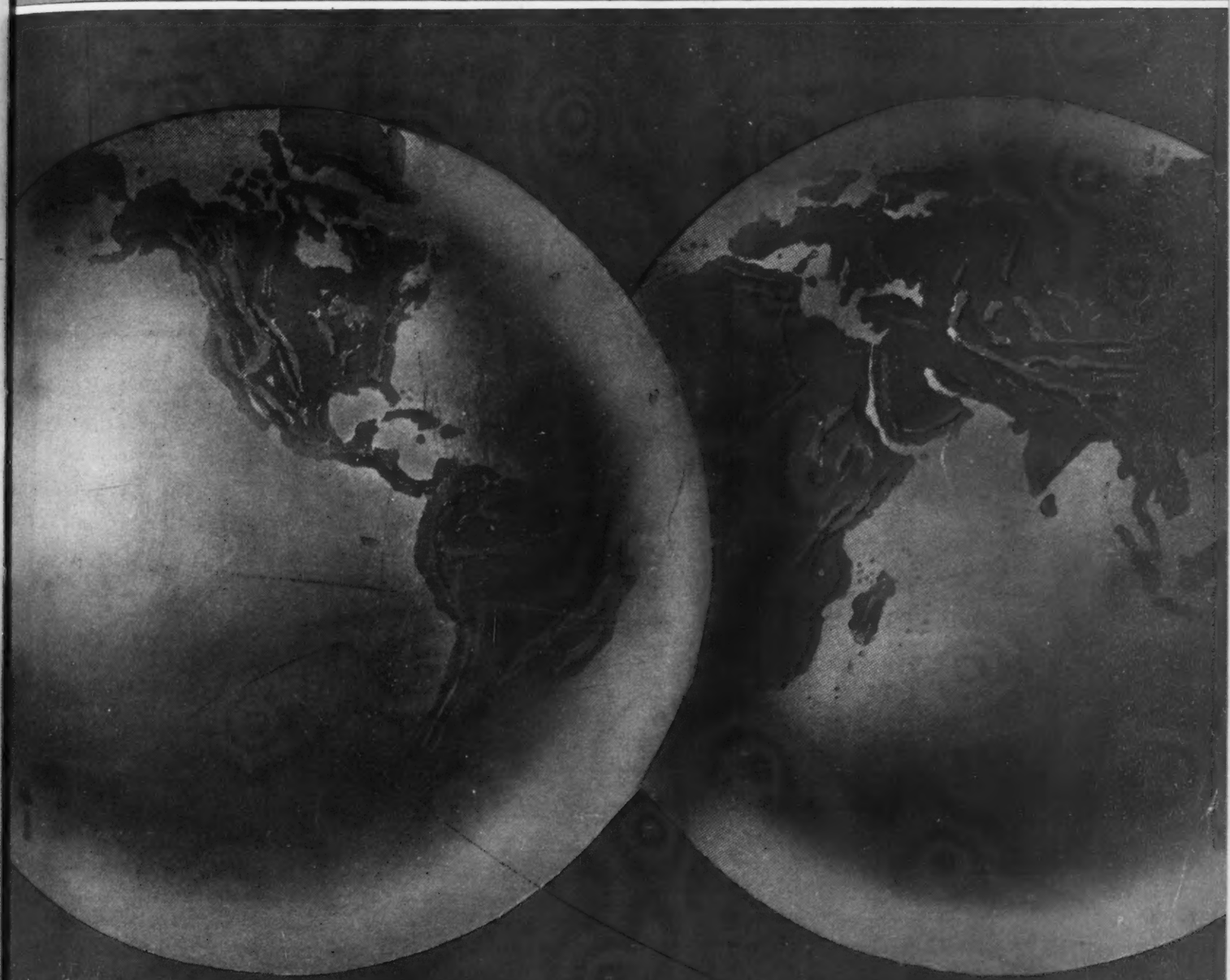
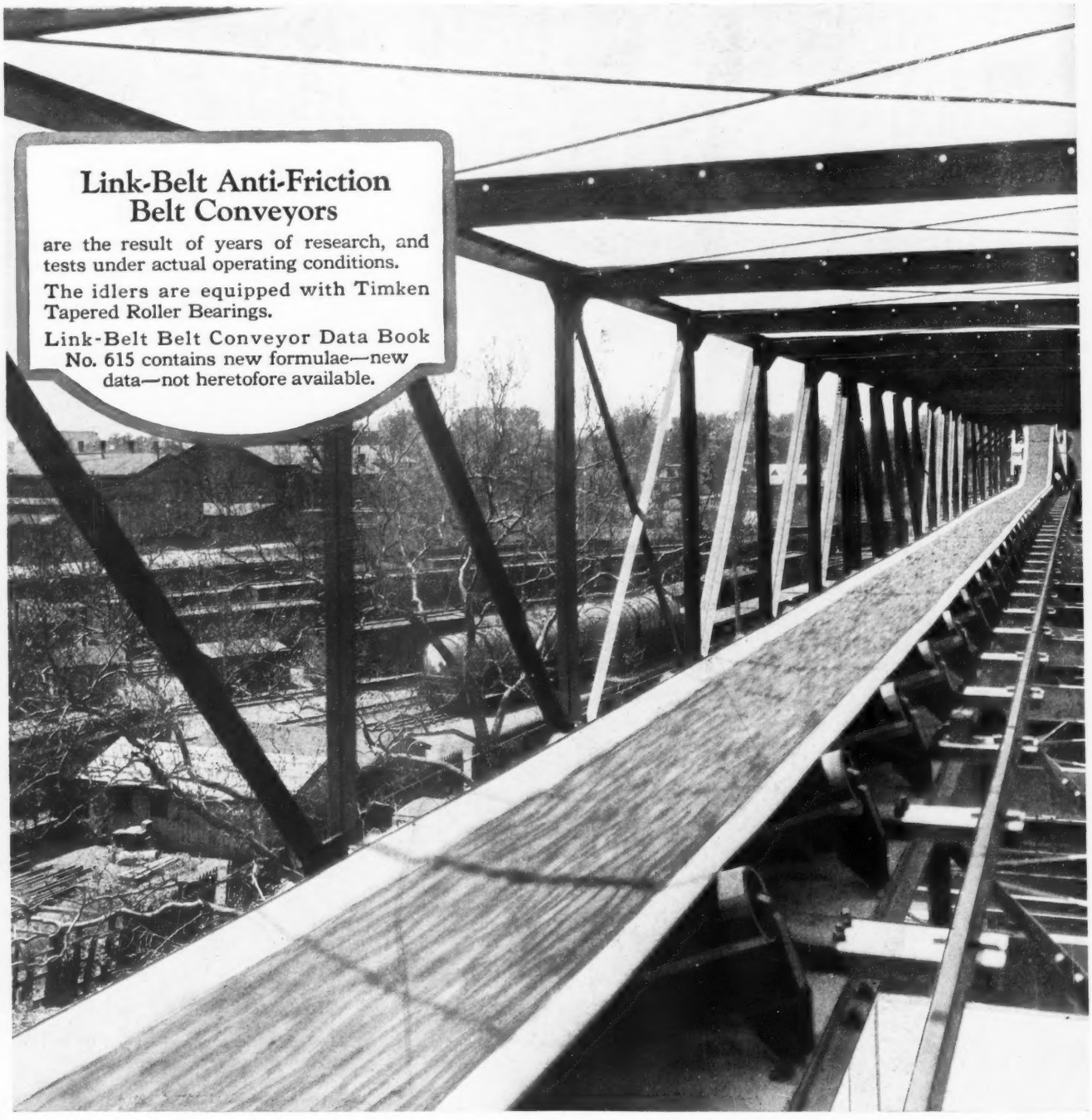


Fifty-Ninth

ANNUAL REVIEW NUMBER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ENGINEERING AND MINING JOURNAL

McGraw-Hill Publishing Company, Inc.
JAMES H. MCGRAW, *President*

A. W. ALLEN, *Editor*

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A DISTINGUISHED industrial leader, in his corporation's annual statement, invariably reported and forecast a condition of prosperity. The authoritative summaries in this, the fifty-ninth yearly review number of *Engineering and Mining Journal,* taken as a whole, might well serve as justification for a similar announcement. Nevertheless, each of the various branches of the broad field concerned with production is so susceptible to internal and external influences, technical and economic, that a wide variation in status is noticeable.

One mining industry reports a stabilized and healthy condition—following a co-ordination of interests—that reflects satisfaction on the part of both producer and consumer; the condition of another mining industry indicates a lack of that control which, in the opinion of many, would have insured an equitable return for the intensive and successful endeavors made to reduce cost of production; that would have permitted the retention of a fair proportion of the profits or benefits, resulting from research, now being shared by the manufacturer, the ultimate consumer and the world at large.

Tracing this trouble to its source is a difficult matter; but the conclusion is inescapable that many of the branches of American industry, having evolved and perfected a system of large production at low cost, are being penalized for their zeal and frugality. The availability of immense supplies of raw and manufactured products has given rise to iniquitous buying practices, the basic-material producer being at the end of the line and receiving the worst of the deal.

WITH a primary material of uniform grade—a metal of high or standard purity, for instance—no quality factor enters into the question of competitive marketing. An intense but healthy rivalry among technicians has served its purpose in stimulating research and thereby securing metallurgical success, the avoidance of waste, and low production expense. Technical developments of moment to the mining industries will continue to be reported; but the consensus of opinion indicates that the major improvements possible have been made, and the more obvious production economies have been effected, in large measure because of the part played in the last half century by *Engineering and Mining Journal* and *Mining and Scientific Press,* in their service of editorial leadership and by the prompt and frequent dissemination of a continuous record of progress.

Technical success, however, involves the co-operation of the manufacturer, whose research program must not be curtailed, as is now threatened. The open competition that resulted in meritorious technical achievement is being followed by an underhand warfare among purchasing interests—a discreditable conflict that, unlike technical rivalry, has only one purpose—monetary gain. Notwithstanding this distinction, many government spokesmen persist in viewing any and every type of competition as desirable, even commendable, because, forsooth, the ultimate result may be a lowering of prices, though at a cost of depleted resources and industrial disorganization.

INDUSTRY, however, not being bound to follow in the devious paths of "diplomacy" or politics, is entering a new era of domestic understanding, with capital and labor sharing more fairly in the fruits of enterprise, with plans in practice and maturing for employee representation, more healthful conditions for all classes of workers, greater contentment and a broader enjoyment of life. As a cause or an effect—one cannot say which—has come into view in sharper outline the truism that the application of humanitarian principles in commercial endeavor connotes good business judgment.

Overworked phrases, the precise meaning of which defies analysis, are due for the discard. "Debunking"—a word recently coined for service in a campaign to correct a condition that threatened to become chronic—will find extensive application. The efficient conduct of government and the helpful direction of industry, let us hope, will be classed as engineering problems and solved as such. A humanitarian direction of affairs will insist that open co-operation and arbitration shall supplant secrecy and underhand manipulation, thereby repeating in the field of marketing and distribution what already has been achieved in technology.

A. W. Allen

In Behalf of Our Profession

IT IS perhaps unnecessary to remind the members of our profession that *Engineering and Mining Journal* has always been desirous of working in friendly association with the engineering societies, for the furtherance of the best interests of the mining industry and of those engaged in directing its manifold operations. The American Institute of Mining Engineers was founded fifty-seven years ago in the editorial sanctum of this journal; and its editor at that time, Rossiter W. Raymond, became not only the secretary of the Institute but its guiding spirit for the period of a generation. He was editor of *Mining Journal* and secretary of the Institute concurrently for six years; and his equally distinguished associate, Richard P. Rothwell, became president of the Institute while editor of *Mining Journal.* These facts serve to emphasize the close relationship that persisted for many eventful years between the two organizations. At one time, indeed, *Mining Journal* was the organ of the Institute, and when each of them outgrew their adolescence they continued to fraternize. In later years several editors of *Mining Journal* have been prominent in the secretarial administration of the Institute, and today the secretary is a former editor of the *Mining and Scientific Press,* which also was a consistent friend of the Institute until the publication of the Institute magazine provoked legitimate antagonism. The Mining and Metallurgical Society of America, organized in 1908, derived its chief impetus from a secretary, Mr. Walter R. Ingalls, who was also editor of *Mining Journal;* and much of its excellent work in gathering and systematizing current professional experience was initiated by another editor of *Mining Journal,* Mr. J. E. Spurr.

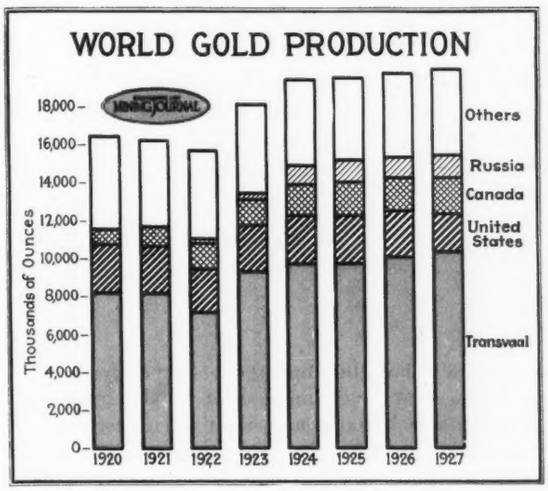
One manner by which co-operation between the technical press and the engineering societies can be effected is suggested by the friendly action of *Mining Journal* in publishing the valuable paper of Dr. Max Mason on geophysical prospecting, read before a joint session of the A.I.M.E. and the M.M.S.A. recently. The immediate purpose was to elicit discussion on a timely and important subject before the date of the Institute's annual meeting in February, but the incident provides also a happy illustration of the manner in which the three organizations can work together in the common interest. Obviously, the technical press should be the strongest supporter of the engineering societies; and they in turn should recognize the fact that technical journalism, of the independent type, merits their hearty good-will, rather than their covert antagonism; indeed, I do not hesitate to say, as I have said more than once before, that independent journalism, such as is exemplified by the entire record of *Mining Journal,* is even more necessary to the welfare of the profession than are its societies, which, being directed by groups of members that are themselves prominently engaged in the metal and mining business, are inevitably in danger of representing special interests, without necessarily involving any definite moral aberrancy. The editors of the technical press, including both the papers now consolidated in *Engineering and Mining Journal,* have been so completely detached from the actual business of mining as to be able to give the members of our profession at all times a forum in which any subject pertinent to their daily work could be discussed freely and frankly. That open forum has been a notable asset to the mining and metallurgical industries of the United States.

We may take warning from our friends on the other side of the long unfortified frontier that bespeaks the good neighborliness of Canada and the United States. In the Dominion, the Canadian Mining Institute publishes a bulletin, the effect of which in one respect has been to check the progress of a national mining journal adequate to the needs of the expanding mining industry of the country. The Canadian Institute has done good work, of course, in promoting the solidarity of the profession in the Dominion; but the question may be asked fairly if a strong and independent mining journal would not have been even more useful. The Institution of Mining and Metallurgy, in London, has refrained carefully from any kind of journalistic adventure, and, in consequence, it has become not only the unquestioned exponent of the British mining profession, but it has escaped the financial perplexities that have embarrassed the two Institutes on this side of the Atlantic.

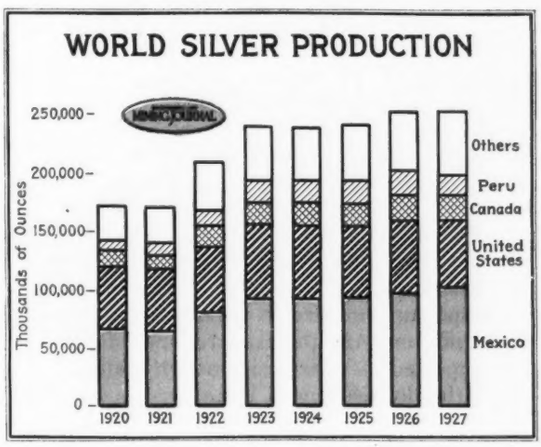
The Mining and Metallurgical Society of America, the youngest, the smallest, but by no means the least important of these kindred organizations, has initiated several highly useful inquiries and has collected a considerable volume of valuable economic information, chiefly by means of its meetings in New York, with which city it is mainly identified; but it has never grown in membership to an extent that would warrant its national title. It appears now that a by-law is proposed to restrict membership definitely to 450. This seems regrettable. In the first place, the mining industry of the United States would be in a bad way if only 450 men were eligible to a first-class professional organization; in the second place, if the Society is doing useful work, as is generally conceded, it should endeavor to broaden, rather than to narrow, the scope of its usefulness. If it is to follow in safe and ascending footsteps it might well take a hint from the Institution in London, by trying to make its membership thoroughly representative; and by devoting even more energy to the kind of work—economic and statistical—that has signalized its activities in the past. Most of our senior engineers undoubtedly have a friendly interest in all three agencies—the Institute, the Society, and *Mining Journal*—and many of them belong to both the Institute and the Society, besides, of course, being subscribers to *Mining Journal;* they happen to be among the most influential members of our profession; to them, therefore, I venture to submit these considerations, asking them to use the weight of their influence in behalf of wise measures for friendly co-operation in the highest interests of the profession, to the welfare of which each of these organizations is dedicated.

T. A. Rickard

GOLD



SILVER



Increasing Canadian Gold Output Compares With Declining Production in United States

By Sidney J. Jennings

Vice-President, U. S. Smelting, Refining & Mining Company, New York

WORLD PRODUCTION of gold in 1927 will probably exceed the production for 1926 in amount almost as great as that year showed over 1925. The Annual Report of the Director of the Mint records the fact that the 1926 output had a value of $398,557,458, which is about five and a quarter million dollars more than the value of the production for 1925.

The production of the Transvaal for 1927 is estimated to be $209,380,000, an increase of about $3,600,000 over 1926. That from Canada and probably from Russia will also show material increases in 1927 over the amounts produced in 1926, which were valued at $36,263,111, and $20,509,659, respectively. The production in the United States in 1926 was $46,276,299, a decline of $1,680,704 from 1925. A further small decline in 1927 is expected. If the production of gold in the United States continues to decline in the fairly steady fashion that has obtained since 1915, when it amounted to $101,035,700, this country will lose second place in the production of gold to Canada, which is yearly increasing its production. The decline in production in Australia and British India will probably continue. This small decrease will probably be more than compensated by increases from several other countries, including Southern Rhodesia, the Belgian Congo, and British West Africa.

An immense amount of gold is known to exist in the placer deposits of Alaska and in the lode deposits of the United States; but the miner realizes that gold is not only a measure of value, but in itself is a commodity of fixed price. If the materials and labor consumed in getting out any given quantity of gold have a greater value than the gold produced, it will be more profitable to the individual producer to leave the gold in the ground, although the world at large will lose the possibility of the many-fold greater amount of credits that could be based on the gold thus left in the ground. Evidently the financial world is determined to use gold for some time to come as a basis of value. The total amount of gold in visible supply above the ground is not sufficient to allow the use of gold by all the nations in the wasteful manner to which the world has been accustomed in the past.

The accompanying table shows the amount of gold consumed in the industrial arts in the United States, from 1922 to 1926, according to the figures of the Director of the Mint.

Gold Consumed in Industrial Arts, United States

Year	Total Amount Used	New Material
1926	$74,333,684	$43,268,236
1925	65,953,870	36,161,849
1924	65,887,851	37,913,310
1923	69,292,245	40,013,175
1922	59,806,052	36,697,980
Totals	$335,273,702	$194,054,550

During this five years the world used in the industrial arts, according to the admittedly incomplete figures reported to the Director of the Mint, gold worth $748,170,935. No distinction has been made in the world figures between old material and new material; but, taking the figures of the United States as a

criterion, 57.8 per cent of this amount would be new material. Thus, every five years, gold to the value of about $432,000,000 is consumed in the arts, much in the form of cheap jewelry and gilding. A tax of $10 per ounce on gold used thus has been suggested. Even if such a tax would not prevent all the wastage, it would tend to prevent some of the loss, and in addition it would yield a considerable revenue over and above the cost of collecting it.

The hoarding of gold in India as a store of value still continues and is the most serious drain on the gold resources of the world. Financiers will watch with interest to see if the suggestions of the Royal Commission on Indian Currency and Finances, when carried out, will have the hoped-for effect of inducing Indians to put their store of value in a bank rather than in a hiding place. The world of finance is fairly well convinced of the logic of one of the findings of that commission—that the time is past for the use of gold as a circulating medium. No country at present feels itself rich enough to afford the inevitable losses attendant on the use of gold for the medium of daily exchange. Some form of gold certificate, which in large measure obviates these losses, will be used more and more. As long as the world is at peace, these certificates are perfectly satisfactory; but as soon as war looms on the horizon people realize that the possession of a piece of paper certifying the fact that a certain amount of gold is at their order in a particular warehouse is a different thing from possessing the gold itself. If people are not willing to take this war risk, and insist on possessing gold, then the demand for gold from the whole world will become so great that the prices of all commodities measured in gold will drop materially. If this should come about, the mining of rock or gravel carrying smaller amounts of gold will become profitable. I do not look for this to happen in the immediate future, but it is a factor which must always be present, as a possibility, in the back of one's thoughts.

The world's production of silver for 1926 was reported to the Director of the Mint as 253,587,088 fine ounces. This is the largest production for any one year. In reviewing the available figures for the first ten months of 1927, and making an estimate for the remaining two months, it seems probable that a small increase may have occurred in 1927 over the production reported in 1926. Production of the United States will be about the same in 1927 as it was in 1926. Mexico, Australia, and Burma will each show small increases, but sufficient to more than offset the anticipated decreases in Canada, Peru, and Bolivia. The seven countries mentioned produced about 88 per cent of the world's production of silver in 1926.

Increased production of silver in Mexico in 1927 was remarkable, occurring as it did in a year when a revolution was attempted and during which the price of silver averaged approximately 5½c. per ounce less than it did in 1926, when an average of 62.107c. in New York was obtained.

It is evident that the Indian government intends to carry out the recommendation of the Royal Commission to reduce the amount of silver it holds in its reserves. A sale of a fairly large amount was reported to have been made late in July, 1927, and this report was undoubtedly the largest factor in depressing the price from an average of 56.36c. in New York for July, to 54.72c. for August. The market advanced from that low point to an average of 58.21c. for the week ending Dec. 14. It is highly probable that the Indian government will again take advantage of this relatively high price to sell another lot of silver.

Apparently the nations of the world have re-established to a certain degree their stock of silver subsidiary coins. The following table gives the number of ounces of silver used by the world in making coins for the five years from 1922 to 1926 inclusive; these figures are reported to the Director of the Mint, but make no distinction between new silver and that which was in remelted old coins:

Silver in Subsidiary Coins

Year	Fine Ounces	Year	Fine Ounces
1926	148,055,068	1923	232,998,544
1925	188,306,076	1922	227,210,117
1924	136,817,808		

This shows that the shortage of silver coins brought about by the war, and emphasized by the unwillingness of many nations to purchase silver for coinage purposes at high prices, has been in some measure remedied. The world, however, still needs a large amount of silver for subsidiary coins; and, if production is not increased over the present amount, the price of silver during 1928 should not fluctuate greatly from that which obtained during 1927.

Mica

By J. A. Rogers
Rumney Depot, N. H.

PRODUCTION of domestic mica was not materially increased during 1927, if, indeed, it kept pace with 1926. The use of disk mica in certain types of incandescent electric lamps has been discontinued for the time being; and operators in India have begun punching disk and washer mica, in the production of which they use poorly paid labor, dumping the surplus, beyond what is absorbed by the English markets, into the United States. This is an injustice to American producers. The electrical equipment industry is well protected by tariff, whereas mica used in the construction of such equipment is imported at rates which afford little if any protection to the domestic mica industry.

Scrap mica appears to be in larger demand than during 1926; but, owing to importations from India—the tariff rate being only 10 per cent ad valorem—the market price throughout 1927 remained at from $22.50 to $25 per ton.

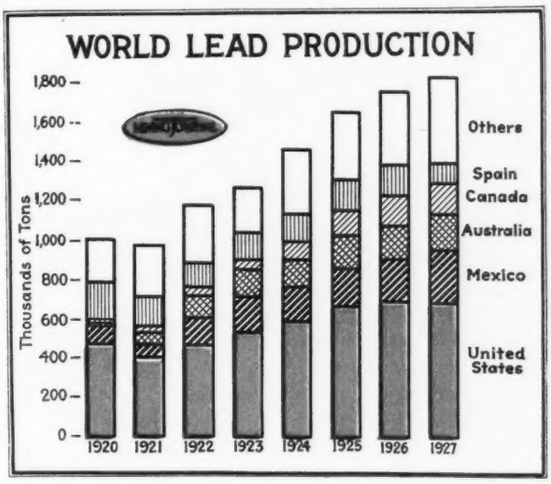
North Carolina mines appear to have been operated at the usual rate of production, but considerable price cutting has occurred in that section. Two or three mines have been operating in the Keene, N. H., district, where production of scrap and low-grade washer mica is incidental to the mining of feldspar.

In Grafton County, N. H., the General Electric Company has continued the operation of the Alexandria mine at a slightly decreased rate of production. The Standard Minerals Corporation, of Rumney Depot, N. H., which recently acquired several mica and feldspar properties in Grafton County, operated only its Valencia mines in 1927, curtailing production to a considerable extent during the year.

LEAD

By CLINTON H. CRANE
President, St. Joseph Lead Company, New York

Larger World Production and Consumption, with Lower Prices



THE salient features of the world's lead producing industry in 1927 may be briefly summarized: First, a world production greater than the maximum of 1926, despite a diminution in the United States output. Second, an apparent consumption greater than the record of 1926, although the American consumption was considerably less. Third, London lead prices approximately 22 per cent less than during the year before, and 34 per cent less than those of the "all-time" peak of 1925. Fourth, the development and discovery of no new lead deposits of major importance. Fifth, the introduction of no serious substitutes for the chief uses of lead. Sixth, the increase of the available supply of lead ores that can be profitably mined and treated, due to the continued development and application of improved, more efficient and cheaper methods. Foremost among these is selective flotation. Were it not for this, from an economic standpoint the first five statements would be contradictory and inconsistent.

PRODUCTION

The production figures for the last two years are about as follows:

(Short Tons)

	1926	1927	Change	Per Cent Change
United States	696,000	678,000	—18,000	— 2.6
Canada	141,000	151,000	+10,000	+ 7.1
Mexico	221,000	267,000	+46,000	+20.8
North America	1,058,000	1,096,000	+38,000	+ 3.6
Australia	167,000	185,000	+18,000	+10.8
Spain and Tunis	182,000	168,000	—14,000	— 7.7
Germany and Silesia	108,000	121,000	+13,000	+12.0
Burma	61,000	73,000	+12,000	+19.7
All others	182,000	185,000	+ 3,000	+ 1.6
World total	1,758,000	1,828,000	+70,000	+ 4.0

The United States and Spain were the only two countries showing a production decline. In the United States the deliveries for consumption in 1927 were slightly greater than the domestic output, the excess of imports over exports being partly offset by an increase in producers' stocks. Except for some changes in production, conditions in the three major lead districts of the United States continued much the same as in the previous year. No changes occurred in the wage scales; and, as the cost of living was a little less, the miners were probably better off than ever before—a state considerably different, be it noted, from that of some of the employers.

In Southeast Missouri the combined output of the three operating companies dropped about 2 per cent, this in spite of an added production from the old Mine la Motte, which was reopened by the St. Joseph Lead Company, the ore being milled at Flat River. The strike of the union miners in the Illinois coal fields did not delay operations, because it was anticipated by the accumulation of ample stocks, and coal from the non-union Kentucky district could always be had. The lead production of the Tri-State district declined nearly 25 per cent, many mines being closed or only partly operated. Selective flotation in the treatment of slimes has already started in this field and probably accounted for about 1,000 tons of lead during the year.

The ore shipments of the Utah district showed an increase, as probably did the lead production. The two selective flotation custom mills operated at full capacity, and the result was particularly marked—it has been estimated that the mining companies netted an additional $3,500,000 during the year. In the Coeur d'Alene, operations were continued as usual on the three main veins, the Bunker Hill, the Hecla, and the Morning, although there was some curtailment, principally by the Hecla Mining Company. One of the largest mills in this district, which now is on a basis of complete selective flotation, probably could not have been operated at all with the older methods and at present costs and metal prices.

In New Mexico, the American Metal Company started operations at its Pecos property, which by an all-selective flotation concentrator is producing lead at an annual rate of 6,000 tons. In Arizona, the Phelps Dodge Corporation blew in its new lead smelter and is now making over 1,000 tons of bullion monthly from mines in the Southwest and in Sonora.

Elsewhere than in the United States and Spain, the high prices of the preceding three years, together with advances in selective flotation, so stimulated production that the world output was the greatest on record. The Mexican increase is relatively the largest of any country in the world, in spite of continued governmental con-

troversies, unfavorable legislation, and an embryo revolution. Probably nearly all of this increment is due to selective flotation. In Canada, as usual, the majority of the output, and of the increase in it, originated at the Sullivan mine, in British Columbia, which mined some 4,000 tons of ore daily. All this ore is treated by selective flotation, without which method the annual lead production would be some 100,000 tons less than at present.

The Spanish mines are said to be playing out, and undoubtedly their operation has been seriously affected by the lead price. The Peñarroya company has long been endeavoring to acquire mines in Africa, Italy, and the Near East, but has met with little success. The Spanish government seems to be averse to any policy of curtailment, and has recently adopted a system of financial aid to the independent miners. At present about 17,000 short tons of lead is being annually produced by selective flotation in Spain, France, northern Africa, Turkey, and Asia Minor. In Belgium, Germany, and Upper Silesia the production in 1927 was more than during the previous year.

In view of the low lead, zinc, and silver prices, the augmented production of Australia is noteworthy, as operations have continued to be hampered by labor legislation. The Broken Hill Proprietary Company has stated that this has made it almost impossible for improved appliances to reduce costs enough to add lower-grade ore to profitable reserves. Most Australian lead mines have recoverable zinc values, so the use of selective flotation is indicated by the increase in the zinc output of the continent from 4,000 tons in 1918 to 53,000 tons in 1926. It was commenced in 1912 at Broken Hill by the development of the Lyster process at the Zinc Corporation. This was followed by the methods of Owen at Broken Hill South and by Bradford at Broken Hill Proprietary Company. In Australia today selective flotation is responsible for an increased lead recovery of about 12 per cent; and, owing to replacement of gravity methods, the lead production by it is now about one-quarter of the total. Burma, also, shows an added tonnage resulting from the same cause. There, the zinc recovery has been greatly increased and has justified a larger mine output, even though the lead recovery ratio has been slightly reduced.

Consumption and Prices

The 1926 world lead consumption was estimated at 1,690,000 short tons. In the absence of data regarding foreign stocks, the 1927 consumption cannot yet be evaluated, but a guess at an analogous figure of 1,770,000 tons—a 5 per cent increase—is probably as good as any. Inasmuch as the consumption of the United States dropped some 7 or 8 per cent from its previous amount, it would seem that the remainder of the world used 14 to 15 per cent more than during the previous year. This is certainly a remarkable record that can be explained only by the improving industrial conditions, steady rehabilitation of European countries, and by the stimulus given to demand by the lowered price. So far as lead is concerned, this applies particularly to Great Britain and Germany.

In the United States the decline in deliveries for consumption was due to a slight drop in the schedules of the large manufacturers, and also to a sharp decrease in the so-called "invisible" stocks. To guard against a possible shortage, the heavy users of lead had been carrying large inventories of the meal, but in 1927 this danger had disappeared, and also the improved freight service afforded by the railroads made prompt deliveries more certain. The stocks in the hands of many users were reduced probably 50 per cent, thus causing the tonnage purchased to be materially less than that actually used.

At the beginning of 1927 the New York price was 7.80c.; at the end it was 6.50c. The original prevalent feeling that prices could not drop below 7.50c. while general business remained active was exploded by April; and early in the summer a rather heavy tonnage was stocked by the producers, who then believed that any price as low as 6.50c. would be short lived. Actually, however, with the exception of a slight rise in August, the New York price remained below 6.50c. for seven months—the lowest figure since 1922. In July, many producers commenced unloading stocks, which began to decline as the buying wave continued. The year ended with the market in a healthy condition, with moderate stocks, a steady demand, and an increased amount already sold on average price contracts for 1928.

Selective Flotation

Great improvements in mining, milling, and metallurgical technique, and in labor administration and service, have been introduced or extended since the war and all have done their share in lowering the cost of producing lead and in making commercial much ore previously considered worthless. Among them may be mentioned greater mechanization, cheaper power, finer grinding, more efficient milling equipment, and higher smelter recoveries. But none has had the tremendous effect of selective flotation.

Selective flotation has accomplished an efficient separation of the values in complex ores. Thus a zinc-lead ore, in which the sulphide particles are intimately associated, can be parted before smelting into separate concentrates, both of which are distinctly salable. There is a large tonnage of such ores; some of them could never be profitably worked by the older methods, and others only when the metal prices were abnormally high, as only part, if any, of the zinc was recovered at the mill, and the balance was penalized by the lead smelter, since it was necessary to force it into the slag. By selective flotation, not only is there a good zinc recovery, but the recoveries of lead and other metals in non-penalty form are generally increased. The re-working of millions of tons of old waste dumps has created a new source of revenue without depletion. Mines formerly worked for lead and silver only and which contain more zinc at greater depths can now be continued on a profitable basis. Selective flotation has caused the rejuvenation of zinc-lead mining, but, in increasing the supply, it has naturally depressed the prices of both metals. Probably its effect on zinc—present and future—is and will be much more pronounced than its effect on lead.

It is impossible to make anything more than a rough estimate of the increase in the world's lead production that has been or may be caused by selective flotation. There are too many variables, although all do not apply in every case. The simplest example is an ore with which the older methods could not produce a profit at any metal prices. A more difficult type is a mine that contains more zinc at depth and which, without selective flotation, could only be operated under market conditions

different from those that now exist. Other ores now selectively floated could be worked by gravity and straight flotation mills, even at present prices.

Nevertheless, to obtain a rough quantitative idea of the situation, the largest lead producers of the world were asked to estimate, for their own operations, and for the districts in which they are located, the *increase* in output year by year due *solely* to selective flotation, and the probable future increase. Inasmuch as the sources of the data are hardly comparable, even with many interpolations and frank guesses, the totals of the figures are not accurately commensurable, yet they will serve to show, in some degree at least, the magnitude of the increase.

The first great effect on world conditions was felt about 1923 when the rapid increase began in Canadian production, owing to the solution of the problem at the Sullivan mine. There the necessity for the method was really greater than anywhere else, not only because of the size of the orebody, which represents more lead than all the other Canadian lead deposits combined, but because most of the ore was impossible to treat in any other way. The marked rise in United States production started nearly a year later, and following that the effect of the art in Mexico became appreciable. In Europe the effect so far has been relatively less; in Australia it has been cumulative for longer than anywhere else; and in Burma it has only recently begun. In 1927 the total increases due to selective flotation are estimated as follows: Canada, 110,000 tons, or 73 per cent of its total production; United States, 110,000 tons, or 16 per cent; Mexico, 70,000 tons, or 26 per cent; North America, 290,000 tons, or 26 per cent; and the world as a whole, 440,000 tons, or 24 per cent.

There is so much variation in the estimates of the probable future increase in lead production because of selective flotation that no significant figures can be given. Furthermore, future extensions must largely depend on market conditions and on new discoveries. Yet it is the consensus of opinion that the increase during coming years will be relatively smaller than it has been in the past.

Outlook

It does not seem probable that the lead price in 1928 will be lower than during 1927; in fact it is generally believed that the market has "turned the corner" and that the immediate outlook is better. Industrial conditions abroad seem to be steadily improving, and in the United States they are at least no worse. The money rate remains only slightly above the 1924 low; in general there is a greater feeling of confidence than during the last eight months, and lead is being more widely purchased.

For a longer outlook, statistics are more relevant. Since 1912 the world's yearly production and use of lead have increased from 1,300,000 to 1,800,000 short tons, an average of 100,000 tons every three years. The war wastage and fluctuating market conditions have materially interfered with the significance of yearly figures; yet, assuming the future progression to be an arithmetical one, in 1939 2,200,000 tons will be required. In 1909 Mr. Hoover estimated that in 30 years the demand would be 1,800,000 tons (a figure about that of 1927), and prophetically remarked that where such a stupendous amount was to come from at the then range of prices and even with reduced production costs was far beyond any apparent source of supply. Actually, for the intervening eighteen years, the question has so far been solved. Last year the lead price, expressed in terms of other commodities, was little greater than in 1909, and costs, as similarly measured, have been materially lowered. And yet few new lead deposits of prime magnitude have been discovered. For the immediate future, there is the rather small Newfoundland deposit, probably later the Australian Mount Isa, and perhaps some supplies from South America, but they cannot offset the progressive exhaustion of many of the world's oldest and greatest mines. So far, the demand *has* been supplied, and the increasing application of selective flotation has been the answer.

In a few years the problem may be as acute as ever. Most authorities believe that the effect the art can have on lead production has nearly reached its peak, but even though, at other price levels, additional supplies be provided by the enlargement of existing operations and the reopening of old mines, there still seems the possibility of a shortage in the production of lead in the not too distant future.

Borax

By Paul D. V. Manning
Chemical Engineer, South Pasadena, Calif.

THE BORAX market in 1927 was one in which the buyer had much his own way. Prices in 1925 reached $95 per ton delivered, whereas the quoted price during the latter part of 1927 was $65, and borax was reported as having been sold at a figure as low as $50 per ton in New York. As is the case with many other commodities, quoted prices are not indicative of the real condition of the market. Prices are given, but buyers have been able to make purchases at lower figures by "shopping."

The American Potash & Chemical Company reached full production in 1927 of 125 tons per day at its Searles Lake plant—the largest in the world. The borax is a byproduct in the manufacture of potash from the saline brines of Searles Lake.

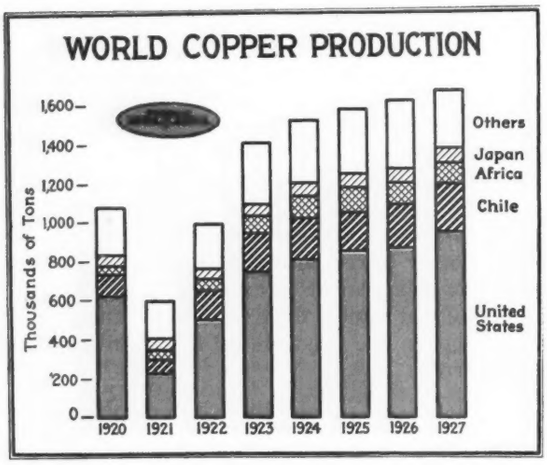
The Pacific Coast Borax Company began the development, during the early part of 1927, of its holdings near Rich, in the Mojave Desert, where it controls extensive deposits of a new borax mineral, a sodium borate with four molecules of water of crystallization, $Na_2B_4O_7.4\,H_2O$. Reported production is about 5,000 tons per month. This mineral is mined at a low cost, with a railroad haul of about 150 miles to the refinery at seaboard. As borax is marketed on the basis of the 10 water-molecule compound, a ton of the new mineral is equivalent to considerably over a ton of the ordinary form. Because of production at these new workings, the Death Valley works have been shut down. Borax is also being produced by the West End Chemical Company at Searles Lake.

Expected new uses for borax, colemanite, and ulexite did not materialize in 1927. It is possible that borax may replace soda ash in specialized fields if prices continue downward to such a point as will establish a competitive basis.

COPPER

By T. WOLFSON
President, Metals Sales Corporation, New York

Improved Economic Conditions Expected When Comprehensive Data Are Available



IN REVIEWING the copper industry for 1927 from the commercial standpoint, one is impressed by the great progress made in improving marketing standards in the United States.

Technically or metallurgically, copper holds a position second to none; but market-wise it has been the subject of criticism for many years. The buying of copper is not a day-to-day matter; it occurs in waves, followed by dull periods. During such periods the market has been vulnerable to the attack of any seller whose sole interest was a profitable turnover. News of a forced sale, spread broadcast at such time, perhaps of a comparatively insignificant amount, has often been the cause of turning the market downward, although the metal might then be in an unusually sound technical position, judged by production and consumption.

It has long been recognized that accurate information was needed about the state of the industry all over the world. The formation of Copper Exporters, Inc., representing in its membership about 95 per cent of all the copper produced in the world, has helped a great deal in spreading such information so far as the export market is concerned. It was felt, however, that insufficient information was available about the state of the industry in the United States, as the only data the industry had was the monthly publication of production, shipments, and stocks furnished by the American Bureau of Metal Statistics. This deficiency, it is hoped, will be supplied by fuller information to be furnished by the Copper Institute, recently organized, which will keep its members more frequently advised as to vital conditions in the industry.

A comparison of copper consumed in the United States and in Europe, in 1913 and 1926, is as follows:

	1913 (Metric Tons)	1926 (Metric Tons)		Per Cent
United States	362,125	820,300	Gain	126
Europe	645,000	625,700	Loss about	3

These figures are significant, showing that whereas the United States was gaining in consumption at the regular yearly rate of increase determined by past experience, the European countries, because of war disturbance, were standing still or slipping. The year 1927, however, tells a different tale, as indicated by the export figures furnished by the American Bureau of Metal Statistics:

Exports from North and South America

Eleven Months of 1926	Eleven Months of 1927
Short Tons	
473,024	578,228

The gain of 105,204 tons shows the rapid recovery taking place in European countries, in which Germany is at present leading, with France also showing signs of revival, and Russia coming to the fore as an important customer. Progress in Europe for the last ten or twelve years has been retarded because of financial troubles; consequently the present demand for copper, to make up for lost time, is the more acute, especially in the electrical field. There is every reason to believe that 1927 marks the beginning of an improvement in European conditions that augurs well for the industry in the next few years.

Domestic deliveries, however, for the first eleven months of 1927, show a considerable decline, as contrasted with those for the same period in 1926, which was the banner year, the figures (short tons) being as follows: 1927, 763,982 tons; 1926, 840,232 tons. The difference — 76,250 tons — represents a considerable amount, yet only a small part of it is due to recession in business from the peak of 1926. The bulk of it is accounted for by a readjustment of inventories in consumers' hands.

For some time in the United States a change in buying policy has been taking place in nearly all important commodities. Instead of carrying stocks of from two to six months' requirements, as has been customary, all the large industries now carry the minimum amount of stock required to continue operations most economically, thus throwing the burden back to the producer. The economical advantage of this change cannot be denied, although it was somewhat difficult for the producers to adjust themselves to it, and this also accounted in large measure for the lower prices prevailing in 1927. The change having run its course, and the producers having become accustomed to the new conditions, the price has recovered to where it was a year ago.

Statistics on mine production and stocks, as compiled by the American Bureau of Metal Statistics, are as follows:

Copper Production in the United States First Eleven Months of

	1926	1927
	—In Short Tons—	
January	71,026	76,198
February	68,131	69,202
March	75,728	69,314
April	73,454	71,122
May	73,542	71,613
June	71,317	69,539
July	72,228	65,545
August	72,014	67,248
September	72,627	65,936
October	75,099	68,959
November	74,947	67,813
Total 11 months	800,113	762,489

Stocks of Copper, 1926-27

	In Short Tons North and South America	Great Britain	Havre
Dec. 1, 1926	351,335	39,575	10,609
Dec. 1, 1927	340,945	14,346	1,929
Decrease	10,390	25,229	8,680

The reduction in world stocks of 44,000 tons is almost wholly accounted for by the decrease in production shown above. The public stocks in Great Britain, known as Standard Copper, were as high as 62,000 short tons two years ago. This amount has been gradually reduced by withdrawals to electrolytic refineries and for making sulphate, so that stocks there are now, it is believed, the lowest on record. This is important to the copper industry, removing the danger of wild speculation on the London Metal Exchange.

Copper Exporters, Inc., was formed in October, 1926, and was immediately subject to a barrage of criticism from interests diametrically opposed to those of the producers, who tried to enlist the sympathies of the consumers against this organization and predicted all kinds of dire happenings inimical to the welfare of the consumers. What has been the result? The organization has been functioning now for about fourteen months, and both producer and consumer have every reason to feel satisfied with what has been accomplished; expressions of good will have been received from nearly all the consumers in Europe. It has removed for them the danger of speculation in purchases of the metal.

The benefits to the producer of having accurate information as to the conditions in the export market have been incalculable; but it was felt that such data should be supplemented by accurate information with regard to the domestic market; hence the formation of the Copper Institute, the object of which is to gather accurate information more frequently than has been possible in the past. Wide price fluctuations are sometimes due to fear of unknown conditions. With reliable data as to the state of the industry in both domestic and export markets, it is felt that a degree of stabilization not heretofore enjoyed can be secured.

Another interesting development is the recent formation in Germany, Belgium, and France of copper and brass research associations, patterned after the one organized here about five or six years ago. These associations have for their membership the producers and consumers of copper, with the sole object of promoting uses for the metal. I believe a good part of the increase in consumption of copper in the United States during the last few years is due to the publicity and excellent promotion work done by the domestic association.

Arsenic

By F. Y. Robertson
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PRIOR to 1901, England and Germany were the sources of the main supply of arsenic. In 1911 the production of arsenic in the United States was only about 3,000 tons. In 1925 the United States production of refined arsenic was 10,997 tons, with 9,314 tons imported, a total of 20,311 tons of available arsenic during that year. This was far in excess of the amount consumed, and the price dropped from 6c. at the beginning of 1925 to 3½c. in December, 1925.

In 1926 the production of refined arsenic in the United States was 6,221 tons, and imports were 7,730 tons, a total of 13,951 tons of available arsenic, or 6,360 tons less of available refined than in 1925. United States production for 1927 was about 10,310 tons, and the approximate total imports were as follows: from Mexico, 8,942 tons; Canada, 1,902 tons; Japan, 938 tons; Europe, 371 tons. The total supply available in the United States in 1927 was therefore about 22,463 tons.

The stock of refined arsenic on Jan. 1, 1927, was 1,798 tons, as compared with a stock of 5,950 tons at the beginning of 1926; and it was confidently expected in the earlier part of 1927 that an increased demand would arise. Although this expectation has been met in part, the arsenic situation throughout 1927 was quiet.

The price of arsenic in 1926 averaged less than 3½c. per pound, which was considerably less than the cost of production; and it was hoped that, beginning Jan. 1, 1927, with only 1,798 tons of refined arsenic in stock, the demand would increase sufficiently to provide a price that would show a slight profit to the producers, or at least would cover cost of production. This hope, however, was not realized, although a considerably increased demand occurred for refined arsenic. The price of arsenic for the first seven months of 1927 was fairly well stabilized at 3.75c. per pound, and for the remaining five months at 4c. per pound. A large proportion of this arsenic was used in the production of calcium arsenate, for use by cotton planters against the boll weevil. Owing to climatic conditions and low prices of cotton, a comparatively small acreage of cotton was given this treatment in 1927, and it is estimated that a considerable stock of unsold calcium arsenate is on the hands of the manufacturers. It is therefore obvious that the use of calcium arsenate in the South is an uncertain factor.

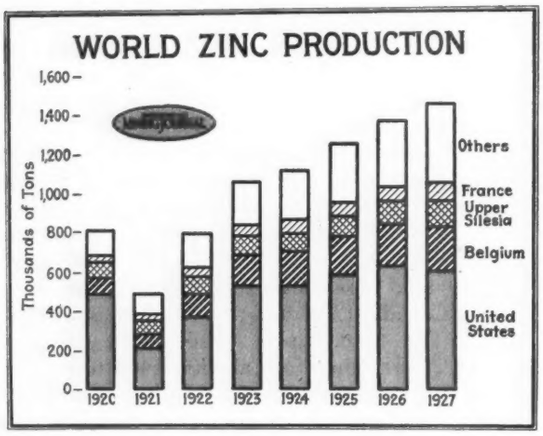
The demand from manufacturers of lead arsenate, paris green, bordeaux, and such mixtures, and for use in poison bait, weed killer, cattle dip, and glass, has been good, and it is estimated that about 75 per cent of white arsenic in 1927 was used for insecticides, 15 per cent by glass manufacturers, and about 8 per cent in the manufacture of sodium arsenate.

Use of arsenic as a wood preservative is being given careful consideration, and for several years the Forest Products Laboratory, at Madison, Wis., has been conducting extensive research, not only against decay but against insects of various forms. Should such investigations prove that arsenical compounds can be used advantageously in the treatment of telephone and telegraph poles, railroad ties, piling and fence posts, in competition with creosote and other compounds now used as wood preservatives, the market for arsenic will be broadened.

ZINC

By STEPHEN S. TUTHILL
Secretary, American Zinc Institute, New York

Profitless Expansion of Output and Low Selling Price Call for Remedial Action



ZINC, in the United States, is undergoing its second readjustment since the World War. The first was the bringing of war-time production down to a peace-time consumption basis. Now it is the shifting of the supply sources of zinc concentrates and slab zinc.

It is estimated that the 1927 world production of slab zinc was about 1,450,000 tons—an increase of 5 per cent plus over 1926. It is also estimated that the United States produced 42 per cent of this slab zinc tonnage, or 612,000 tons, a decrease of 4 per cent plus, as compared with 1926. Nevertheless, there was a marked tonnage increase in zinc recovered from complex Western ores as a result of improved metallurgical processes; also a relatively large output of slab zinc in the mining states, with plans under way for an early increase in slab-zinc productions in Montana and Idaho.

Referring to the older method of converting zinc concentrates into slab zinc, one finds that the percentage of operating to total capacity gradually fell in 1927, with a loss at the end of the year of 10 per cent. This naturally reacted upon the Mid-West ore field, from which almost all the zinc furnaces draw their concentrates. At this point it may be well to state that the national organization of the zinc industry—the American Zinc Institute—has, since March, 1927, issued its slab-zinc statistics at semi-monthly intervals, instead of monthly, with added features. It has published, also semi-monthly, beginning with June, 1927, a statement of spot and forward weighted average selling prices (during the period) of Prime Western and Brass Special zinc, together with tonnages. In addition to this shifting of zinc tonnage, the exports of zinc ore and Prime Western metal dwindled as 1927 drew to a close.

Great Britain, which imports three-fourths of the slab zinc it consumes, has lately turned to the Continent for supplies; in fact, Europe, except for High-Grade zinc, is now drawing supplies of slab zinc from her own furnaces.

At the present time, Europe seems also to have an abundance of zinc ores. Indications are that future supplies from the Western Hemisphere will be taken from those countries—Canada and Mexico—willing to ship on formula in use for many years by the European smelters.

Canadian zinc ore developments from Coast to Coast and the increase in the slab zinc output in British Columbia are among the outstanding features of 1927. The output of Mexican zinc ore is increasing yearly. Comparing the 1927 exports of zinc-coated (galvanized) products with those of 1926, the United States shows a marked decline. Great Britain shows an equally marked increase.

Even if the question of zinc concentrates and slab zinc tonnage losses in the United States could not be charged in part to a general slowing down in industry and a general lowering of price levels in the fourth quarter of 1927, it would, nevertheless, be secondary to the problem involved in the shifting of domestic sources of supply of zinc ore and zinc metal. The output of those practicing the older form of zinc-metal manufacture is largely of the grade known as Prime Western, for which the ores of their principal source of supply are extremely well adapted.

A few years ago 50 per cent of the slab zinc produced in the United States was used for zinc coating (galvanizing); in 1926, 46 per cent; in 1927, 40 per cent. Today the total percentage of zinc-coated sheets to the total production of sheet steel is 25 per cent; the percentage of roofing to the total production of zinc-coated sheets is 40 per cent; the percentage of corrugated to the total production of roofing sheets is 85 per cent.

It would even seem to the "man on the street" that an immediate and intensive cultivation of the domestic zinc-coating field would greatly assist in restoring the status of the ore and metal producers primarily interested in the manufacture of Prime Western zinc. It is also the opinion of the Sheet Steel Trade Extension Committee that such a market has large possibilities, especially in zinc-coated roofing and siding. That organization of independent sheet-steel manufacturers has for several years been devoting a great deal of time and money in an effort to develop this market by modern research and marketing methods.

It is believed that the government statistics, due in the first quarter of 1928, will show a good volume year in zinc sheets, plates and strips, and in zinc pigments.

Overproduction characterized the two principal branches of the United States zinc industry in 1927. Large buyers of processed goods are watching the surplus processed stocks and the associated surplus raw

material stocks. As overproduction in an industry makes a buyers' market throughout the entire industry, it would seem natural for all producers of goods and materials to confine their output strictly to the known average needs of their customers. Zinc concentrate stocks continue to accumulate, and although the United States produces 42 per cent of the world's slab zinc, yet its stocks on hand are 60 per cent of the world's reserve.

In 1927 the average selling price of Mid-West concentrates decreased 19 per cent, and the average selling price of Prime Western declined 17 per cent.

Another factor detrimental to production and distribution is to be found in our present anti-trust laws. Although favoring the ultimate consumer, these permit the business men of this country to enter into thoughtless if not ruthless domestic competition with one another by forbidding them to enter into co-operative agreements, even when such agreements are economically necessary to prevent the demoralization, if not the ruin, of the industry thus sought to be safeguarded; and, in the case of mining, profitless depletion of national mineral resources. Needless to say, fair profits in industry can only be attained as a result of competition coupled with co-operation.

Although 1928 is a Presidential election year, so many reversals of the "old order" have occurred in recent years that one cannot be charged with Pollyannaism if one expresses the belief that business for the year will, on the whole, be satisfactory.

Platinum

By James M. Hill

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STOCKS of the chief metals of the platinum group in the hands of domestic refiners at the beginning of 1927 were: Platinum, 64,203 oz.; palladium, 31,950 oz.; and iridium, 3,933 oz. Stocks of platinum, the largest in ten years, were 45 per cent greater than at the beginning of 1926, and palladium stocks were 19 per cent larger than in the previous year. Domestic production of new metals of the platinum group in 1927 was less than in 1926 and is estimated at about 4,200 oz. platinum, 3,000 oz. palladium, and 30 oz. iridium.

Imports of platinum metals during 1927 were erratic, owing to the disturbance of markets following the announcement of the Russian sales policy in April. A table of imports for the first eight months of 1926 and 1927 will be found on p. 110 of this issue.

Imports of crude platinum from Colombia during the first eight months of 1927 were at the rate of about 3,000 oz. a month. England has been the most consistent shipper of platinum, sending us during the first eight months of the year 21,093 oz. of platinum grains, nuggets, sponge, or scrap; 9,108 oz. of ingots, sheets, and plates; 443 oz of iridium; 3,302 oz. of osmiridium; 613 oz. of palladium; and 736 oz. of rhodium and ruthenium. Germany, whose metals are presumably of Russian origin, supplied only 544 oz. of platinum grains, nuggets, sponge, or scrap, but 20,869 oz. of ingots, sheets, and plates, 2,696 oz. of iridium, 22 oz. of osmiridium, 50 oz. of palladium, and 119 oz. of rhodium and ruthenium. France supplied very little of the platinum metals imported in the first eight months of 1927, her contribution being 1,934 oz. of ingots, sheets, and plates, 27 oz. of iridium, 64 oz. of palladium, and 44 oz. of rhodium and ruthenium. Australia shipped to the United States 689 oz. of osmiridium and Canada shipped 287 oz. of platinum in various forms and 368 oz. of palladium during the first eight months of 1927.

Exports of platinum ingots, sheets, wire, alloys, and scrap during the first eight months of 1927 were 14,123 oz., compared with 7,745 oz. in 1926, and exports of manufactures, except jewelry, were 984 oz. for the first eight months of 1927 and 1,382 oz. during the corresponding period of 1926. Germany and Japan are the largest buyers of our exported platinum.

The American market for platinum metals during 1927 was disorganized, owing to the announcement in April that the Russian output would in future be sold through the Amtorg Company. Prior to that time prices were fairly stable. The official quotation for platinum was $112 at the first of the year, $104 in mid-April, and $72 per ounce after June 1. The selling price of large lots began to drop in the latter part of March, from $101 to $103 per ounce, and reached a low of $62.50 to $64.50 per ounce in the fourth week in July, and has been almost stationary since. The price of pure platinum contained in crude platinum, which was $105 an ounce on Jan. 1, 1927, reached a low of $62 an ounce by mid-June. Palladium prices wavered between $58 and $63 per ounce until July, and then sagged to $52 to $54 for large lots and $58 per ounce for small lots. The price for iridium at the beginning of 1927 was $120 to $125 per ounce; it reached $115 to $120 in April, $107 to $110 in July, and $105 to $108 on the last day of October. Osmium was $55 to $60 per ounce during the first half of 1927, and advanced to $60 to $65 an ounce in July. Rhodium, which was quoted at $55 to $58 per ounce most of 1927, broke to $50 to $52 in October. Ruthenium was quoted at $50 to $55 per ounce during the first two months of the year, but dropped to $40 on March 1 and has remained at that figure. The usual fall pick-up in platinum-metals buying for the Christmas trade was not strong in 1927, and the industry was not so optimistic as in other years.

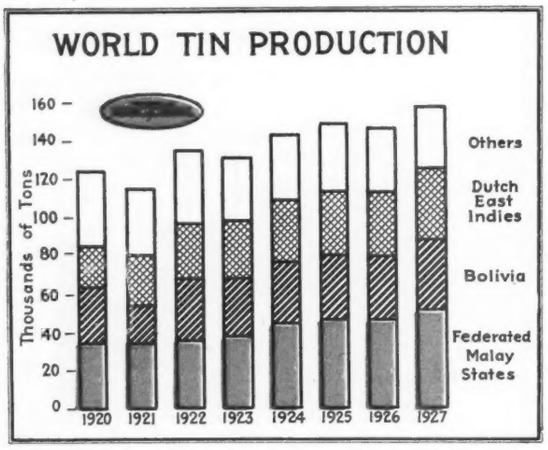
The Union of South Africa in the first eight months of 1927 sold 7,070 oz. platinum, compared with 4,951 oz. in all of 1926. Sales of osmiridium from January to August, 1927, were 3,425 oz., compared with 5,925 oz. during the whole of 1926.

The nickel refineries in Canada produced 5,796 oz. palladium and 5,379 oz. platinum during the first half of 1927—an increase in both metals as compared with 1926. In Colombia, the South American Gold & Platinum Company increased its production, and the British Platinum & Gold Corporation continued operations. Production was less than in 1927, and it is estimated that the platinum output of Colombia will be approximately 60,000 oz. Russia is still building up her platinum industry, and little authentic information is available.

TIN

By E. BALIOL SCOTT
Editor, "The Mining Journal," London, England

Increased World Output and Lower Prices, with Negligible Technical Advances



AT THE CLOSE of 1927, opinions as to the real position of tin, and therefore the outlook for the near future, differed sharply. The history of recent years has been reversed, in that for the first time a larger output and lower consumption were reported than in the previous twelve months. Notwithstanding this, however, the price of cash Standard in London for the first ten months of 1927 was almost identical with that for 1926—the figure for 1926 being £291 2s. 2d. and for the ten months of 1927, £291 16s. 9d. As prices today are considerably below this figure, there can be little doubt that when the average for 1927 is available it will be found that the price for cash will be something below that of 1926. Owing to the heavy decline evident during most of 1927, the prices received by producers will certainly be below the figure for 1926; at the same time, the average will certainly be higher than in any normal year previous to 1926, a year extremely profitable to the miner.

In selecting the chief feature of 1927, I would emphasize the growth in output. The most notable increase for many years past has been recorded, and following as it does on an actual decline of about 4,000 tons in 1926, it seems to mark a definite response by the mines to the climb of prices that has been progressive since 1922. It is impossible at this date to give figures covering every producing field, but only in the case of China is the omission of consequence, and in the estimates that follow it is assumed that Chinese production will not vary greatly from that of 1926; but with the general disorganization existing in that country it is possible that, if and when reliable information does become available regarding the Kochiu field, some further dwindling in that direction may be found to have occurred. In any case it cannot be such as seriously to modify the general result. Speaking broadly, I expect to see an increase for 1927 of 12,000 long tons. Returns for ten months show a gain over 1926 of 10,676 tons, as indicated in the accompanying table.

Tin Production for First Ten Months of 1926 and 1927

	1926, Long Tons	1927, Long Tons	Increases or Decreases
Federated Malay States	38,080	42,557	+4,477
Banka	13,338	12,999	— 339
Dutch ores to the Straits	13,757	15,998	+2,241
Siamese, Indian, and South African ores to Straits	8,057	8,782	+ 725
Bolivia	24,306	27,112	+2,806
Nigeria	5,701	6,467	+ 766

Subtracting the reduction in Banka shipments from the gains elsewhere, a net gain of 10,672 tons is reported, or an average of a little over 1,000 tons per month. It will be seen that the increase is general; for, although shipments from Banka are slightly lower, the increased amount of tin shipped in the form of concentrate from the Dutch mines to the Straits indicates an increase from that source not far short of 2,000 tons.

Consumption as computed from deliveries is lower, following in this respect the history of 1926. United States deliveries for the first ten months of 1927 were 62,280 tons, as compared with 65,405 tons for the ten months of 1926, a loss of 3,125 tons; European deliveries were higher, with a total for the ten months of 31,868 tons, against 29,575 tons for the same period of 1926, an advance of 2,293 tons. Thus, on balance, consumption for the ten months shows a drop of 832 tons; and, with the heavy European consumption recorded recently, it is possible that, by the end of 1927, consumption may be found to have equaled that of 1926. However, nothing will offset the increase in production.

An outstanding feature of the position today is that despite the great increase in production and the slight decline in deliveries, stocks, as represented by the visible supply at the end of each month, show no augmentation. On Dec. 31, 1926, the visible was 15,817 tons, and on Oct. 31, 1927, 14,969 tons. Even if the two years break level when the twelve months' figures for 1927 are known, it will be the utmost that can be expected. Consequently, the problem is: What has become of the additional 12,000 tons or so contributed by production. Opinions differ. As about 10,000 tons of tin is always in transit, the tin trade finds itself with only about 5,000 tons of available stock to meet requirements; and as there is a steady demand for early delivery of metal at a premium, it refuses to see any prospect of prices going below current levels so long as that condition continues. Of course, all sorts of explanations are hazarded, such, on the one hand, as the carrying by speculators of large stocks, and, on the other, an unexpected increase in the amount of tin going direct from the European smelters into consumers' hands without appearing in the monthly statistics; but it is impossible to get evidence of this either way, and the suspicion may be entertained that these stories are invented to account for what is an obvious enigma. Of course, production

statistics relate to a period two or three months later than that revealed in the figures of visible supply, but this hardly seems to me adequate to account for the wide disparity disclosed, and the explanation must be left to develop.

Apart from the statistical position, the year has been remarkable, perhaps, for the increased attention to tin on the part of financiers. An exceptional number of tin flotations has been reported, with large nominal capital subscribed—far more than the tin industry has ever before received. Though a part of this may represent only change of ownership, no doubt a large sum has become available for the industry in the form of working capital, which if reasonably invested promises a continually increased output, at least to the extent witnessed during 1927. Considerable sums have also been utilized in speculation, more particularly in an attempt to maintain cash tin at an artificial premium, based mainly on the paucity of visible supply. These operations were eventually unsuccessful, and the sharp decline in the price during the autumn was the result.

Technically, there is nothing fresh to note. Continued high prices have permitted extensions to mechanical plant, especially in the Federated Malay States, and this has been the chief factor in raising output. However, no corresponding development has occurred in lode mining, and no increase in output has arisen from this source. All one can see at the moment is that the rate of exhaustion of alluvial deposits has been accelerated. Whatever view may be taken of the outlook for the industry over the next twelve months, there can be no gainsaying the fact that the outlook for the metal continues as strong as ever.

Bauxite

By E. C. Harder
Aluminum Company of America, Philadelphia

Bauxite production in the United States in 1927 showed a considerable decrease compared with 1926. The approximate production in 1927 in the Arkansas field will be 315,000 tons, and in the Georgia-Alabama-Tennessee field, 14,000 tons. The respective productions of these fields in 1926, according to the U. S. Geological Survey, were 371,570 and 30,680 tons.

Of the 1927 United States production, 54 per cent was used for aluminum manufacture, 24 per cent for the manufacture of artificial abrasives, 21 per cent in the chemical industry, and 1 per cent for minor uses. A development in the domestic industry consisted in the opening up of the Eufaula district, in Barbour and Henry counties, southeastern Alabama, from which all the bauxite produced in Alabama in 1927 originated. In Georgia, mines were operated in Floyd County, northwestern Georgia, and in Wilkinson County, central Georgia. In Arkansas, bauxite was produced in the Saline County and Pulaski County mines, but the production decreased considerably, owing to competition from foreign sources, particularly from the deposits in northern South America.

The imports of bauxite into the United States in 1927 will probably amount to about 355,000 tons, divided approximately as follows: British Guiana, 160,000 tons; Dutch Guiana, 162,000 tons; Dalmatia, 25,000 tons; France, 13,000 tons. For the purposes of comparison, the imports of bauxite for 1926, as compiled by the Bureau of Foreign and Domestic Commerce, are: British Guiana, 173,141 tons; Dutch Guiana, 48,643; France, 14,069; Jugoslavia and Albania (mainly Dalmatia), 41,950; Italy, 1,428; other British West Indies, 2,245; Canada, 168 tons; total, 281,644 tons.

Exports of bauxite and bauxite concentrates in 1927 from the United States will be approximately 120,000 tons, compared with 87,770 tons for 1926, according to the records of the same bureau.

South American bauxite mining operations are increasing in importance. About 160,000 tons was shipped from British Guiana in 1927, compared with 186,114 tons shipped in 1926, whereas the Dutch Guiana shipments in 1927 will amount to about 170,000 tons, compared with 45,447 tons for 1926.

The average analysis of the British Guiana bauxite now being shipped is approximately as follows: Loss on ignition, 31.00 per cent; SiO_2, 2.75 per cent; Fe_2O_3, 2.50; TiO_2, 2.75; Al_2O_3, 61.00 per cent. This analysis shows that it possesses the unusual characteristic of having a low content of both of the two harmful constitutents, silica and iron oxide.

Dutch Guiana bauxite is in general similar to British Guiana bauxite, but it has a higher iron oxide content and so is not suitable for manufacturing purposes. The British Guiana mines are 65 miles inland, whereas the Dutch Guiana bauxite mines are located about 100 miles inland. Fortunately, however, the Guianan rivers, although narrow, are deep, and permit the passage of 3,000- to 4,000-ton ocean vessels direct to the mines.

In Europe, the leading bauxite-producing fields in 1927 were those of southern France, Istria, Dalmatia, and central Hungary. Production in France in 1927 will undoubtedly exceed that of 1926, which amounted to 408,600 tons. As usual, the main production came from the Var district, but Herault also contributed important quantities. Most of the French bauxite was refined in France and Great Britain.

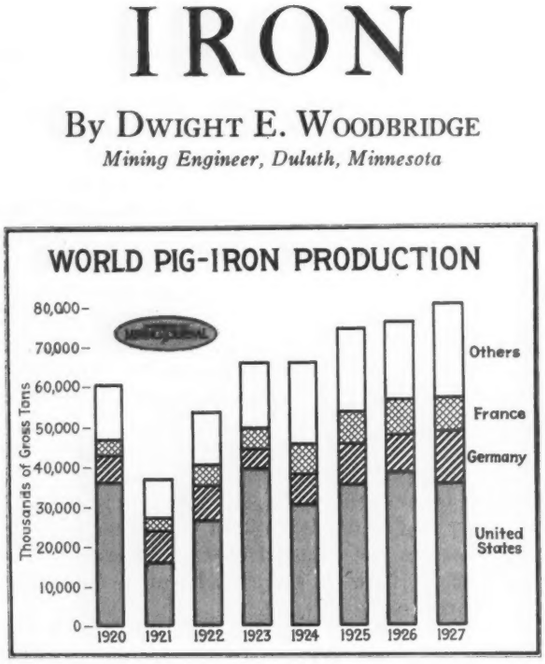
Bauxite production in Italy decreased in 1927 compared with 1926, when the Italian mines produced 85,500 tons. This was due to the fact that in 1927 the German aluminum works obtained most of their raw material from central Hungary, whereas in past years the bulk of it came from the Istrian Peninsula. However, some new bauxite-consuming industries were established in Italy, including high-alumina cement works, and these used a considerable quantity of Istrian bauxite.

The Dalmatian bauxite mines continued operating in 1927 at about the same scale as in 1926, most of the ore mined being shipped to the United States for the manufacture of high-alumina cement. Several new mines were developed during 1927, but did not reach the shipping stage. The outlook for 1928 is favorable for increased shipments.

The principal development in the European bauxite industry in 1927 was the rapid growth of the production of central Hungarian bauxite mines. These were opened late in 1926. About 2,000 to 5,000 tons per month was shipped during the winter of 1926-27; but later in 1927 the production increased to 25,000 tons or more per month. It is estimated that the total production of the central Hungarian mines during 1927 will be about 240,000 tons. Most of this will be shipped to the German bauxite-refining works for aluminum manufacture in Germany.

IRON

By DWIGHT E. WOODBRIDGE
Mining Engineer, Duluth, Minnesota



IRON-ORE shipments from Lake Superior mines in 1927 showed a decrease of about 12 per cent from those of 1926. They total about 52,600,000 tons, with precise figures not available until all rail shipments are in. There are few indications that next season will show an improvement. Prices of ore are unchanged. It is improbable that any rise can be expected soon. Consumers scout the idea; producers are reconciled to the facts.

Practically the same number of men is employed at mines as a year ago—about 19,000 in the district. A few jobs of stripping are under way—most of which will cease early in 1928—extensions of stripped areas and the continuance of programs begun before. No large new developments are planned for the immediate future. As usual, Minnesota produced the bulk of the ore, about 70 per cent, with Michigan nearly 30 per cent, and a little from Wisconsin, where the Montreal mine is the outstanding operation.

I have said so much on taxation in these reviews that I am somewhat tired of the subject; but there seems to be a growing appreciation of what has been meant, and this is a hopeful sign. Perhaps the constant repetition of facts by so many writers and talkers has had effect. A state committee has been touring Minnesota in 1927 investigating the tax situation. It is now believed that it may recommend to the Legislature changes in royalty and occupational taxes. The design of the royalty tax was along inheritance lines, an effort to levy on the payees, but it has been construed by the courts as a charge on the payers. Such construction might have been expected in view of the general form of leases existent in the state. So, to its full extent, the tax is an added charge on the industry and has failed in its purpose. Even its proponents regret this, and another method may be tried. Tax collections on the industry of mining in Minnesota amounted to $21,620,000. This is 24 per cent of the value of the ore as it leaves the mines.

Renewed activity in steel-company mergers, and plans for more of them, have a disturbing effect in the iron

Taxation Problem Deserves Attention—Prices Unchanged

region. They diminish the market for purely merchant ore, but the fact remains that they do not decrease consumption; they shift ownership. In the end, ore now neglected because not held by consuming interests that require it will come into use. But, in the meantime, that ownership may change—a hardship to the individual affected, though of no great importance to general economic life.

Lands are reverting to the original owner, which happens to be the state, not burdened by a tax charge. It is possible that privately owned lands may also revert to the state, if by the continued operation of unjust laws their value is temporarily lost. Indeed, this always has been the desire of a minority faction in Minnesota.

During 1927 work was under way in an effort to extend the probable area of the Cuyuna range on the north side of the Mississippi toward Cass County. Manganiferous orebodies have been located there, and some of the larger operators are planning exploration work along favorable belts of attraction. In this section, known orebodies lie from near the surface to as deep as 300 ft. In general, manganese content runs higher than in the so-called "north range," and silica is lower.

The Manganiferous Iron Company has acquired a Mangan tract near its Louise mine and will operate it in connection therewith. Bodies of manganiferous ore are being explored in the Hillcrest group of lands. The Hanna company has taken over Maroco mine. There are five ore treatment plants on the Cuyuna, crushing, drying, washing, and sintering, and all have been operating more or less steadily during the past season. Three of these crush, one washes, one dries, and one sinters.

Gogebic operations continue to emphasize the search for deep-seated ores, and shafts continue on toward 4,000 ft. At its Geneva, the Oliver is driving a long drift on the 30th level to its Davis workings. There has been some talk of reopening Yale at depths not before attained, but nothing has eventuated. It has been idle for some time. Drilling has been under way near Wakefield. Sunday Lake and Brotherton are being connected by a long drift at depth.

Oglebay, Norton & Company have taken two more properties near Iron River, Mich., carrying the extension of their ore formation near by. The Ford Motor Company has surrendered its option on lands near Alpha, and is doing little except at the Imperial and Blueberry. The former shipped 106,000 tons in 1927, and the latter will be ready in a year or so. It is reported to have been negotiating on manganiferous lands on the Cuyuna, but the story is doubtful. Pickands, Mather & Company are sinking a shaft 1,150 ft. to replace two old ones. It will have steel sets and modern equipment. Thirty mines

were at work on the Menominee during 1927, making a prosperous season.

Siliceous ore shipments from the Marquette were larger than usual, with about 1,200,000 tons produced. Half a dozen mines near Palmer ship this type of ore. One of them, Ogden, is to be abandoned. At Richmond and Volunteer, extensive development programs have been completed. At Volunteer, recently, 430,000 tons of ore was broken in two blasts by the use of one pound of explosive to three tons of ore, charged into 420 well-drill holes.

On the Mesabi, the Oliver company has begun shipments from its new underground Godfrey mine, at Chisholm; it is completing the stripping of its Minnewas, a state lease, from which it is taking about 8,000,000 yd. of overburden. Its new Kerr mine is in condition for heavy production. The chief shipper for the year was Missabe Mountain, a state lease from which it took 5,700,000 tons. From its five million-ton Mesabi range mines it produced as much as 13,174,000 tons, though by no means a record. Its underground Leonidas sent out 920,000 tons, which is quite a feat. Miller mine has been abandoned by the Pitt company after 23 years' operation and the shipment of six million tons. Shenango Furnace Company has bought the fee to its Whiteside lease, and is beginning a program at its Shenango mine, stripping and equipment, that calls for about $600,000. Crosby mine, at Nashwauk, is to be reopened, and stripping will be carried out. From the Hill Annex mine at the Jones & Laughlins Steel Company in one month 245,000 yd. of overburden was stripped by one big shovel and three attending trains. This is supposed to be a record.

A computation of iron-mining profits in Michigan has been made by the state tax appraiser. It shows that profits in siliceous ore mines, open pits, amounted in the year to about 12.5c. per ton, with ore selling at $2.53. The general net profit for all mines in the state was about 19c. a ton, and general costs were proportioned as follows:

Cost Items:	Per Cent of Total
Mining	37.6
Transportation	36.4
Overhead	6.3
Taxes	6.0
Royalty	7.6
Marketing	1.4
Profit	4.7
	100.0

This profit is computed on a selling price of $4.18, Lake Erie, and is based on the maintenance of that price, but it is well known that much ore was sold under price, such as that bought on long contracts, and that this was enough to reduce the profit to, say, 3.3 per cent. Within a few years mining costs have been reduced by the exercise of care and improved methods by about 28c. per ton, and slight savings have been made elsewhere; so that, although ore prices have declined $1.30, there is still the little profit of 19c. per ton. The net is some 83c. under the figure of 1923.

These figures are typical of the entire Lake district, and too much cannot be said for the ability of operators, who, in the face of a maintained wage scale, are able to so cut costs in an industry already highly specialized and efficient. The introduction and increasing use of the so-called slusher hoist for underground mucking has been a chief factor in these savings. This machine is still in the evolutionary state, and, no doubt, time will bring heavier and more powerful slushers, operating over longer pulls, at greater speed, and perhaps even more automatic. Mines are now being laid out initially for heavy slushing operations.

The proportion of Mesabi ore to be treated by one or more of the various methods of beneficiation in common use continues to increase, and for the year amounted to about 38 per cent of all ore shipped; most of this was crushed merely, a lesser amount than usual was washed, some was dried, and none was magnetically separated. The latest and most simple of washing plants is at Corsica mine, Pickands, Mather & Company, where the work of trommel screens, logs, and tables is done by one Dorr classifier, by which water requirements are cut in half and power and men needed are materially reduced.

The largest cargo of iron ore ever handled was last summer on the ship "Donnacona," to Sault Ste. Marie, 16,275 net tons. This cargo was inside Lake Superior and was not limited by drafts of the connecting channels. The largest Lower Lake cargo was by the ship "L. E. Block," 14,975 net tons, to Chicago. These also are instances of the continued changes brought about by the need for greater economy. And if today there is one overtone in the monotonous music of the industry it is just that note—economy.

Silica

By E. C. Speiden
President, Isco-Bautz Company, Inc., Niagara Falls, N. Y.

PROGRESS in the silica industries is evident in three directions: scientific, technical, and commercial. Research on crystalline and amorphous silicas has shown the essential physical differences and has indicated the wisdom of choosing the kind of silica that best meets the need of each separate industry. Witness the work of the Bureau of Standards as well as various private laboratories.

Technically, the findings of science have been applied in producing better grades and grindings, adapted to the needs of the more enlightened users, who, as a result, are better able to specify what is needed.

Commercially, keeping pace with the trend of the times, an aggregation of larger industrial units has taken place, with the inevitable result that better qualities are obtainable, and the industry is becoming more nearly stabilized, greatly to the advantage of user and producer alike. Co-ordinated effort is outstripping individual effort, and improved production facilities, practicable only in large units, must result in lower prices and better qualities for the user and in better service on the part of the producers.

Although 65 to 70 per cent of the earth's crust is silica, it is news to the majority to be told that the opal and the sand-grain are "sisters under the skin," or that the softest of velvety fluffy powders and the harshest of abrasives are but physical variants of the same chemical substance, SiO_2. It is therefore important to repeat that the significant progress in the silica industry in 1927 was toward clearer understanding by producer and user alike that silica is no longer just silica, but a material of many varieties, and that there is definite gain from knowing which form is best adapted to specific need.

UNCOMMON ORES *and* METALS

By H. C. MEYER

Vice-President, Foote Mineral Company, Inc., Philadelphia, Pa.

THE electrical and radio industries have developed new and interesting uses for several of the so-called uncommon ores and metals, and it is probable that industrial evolution will eventually put most of them to service. Several interesting developments are to be recorded to the credit of 1927.

Cæsium—Cæsium is a metal closely resembling potassium in its chemical and physical properties. Indeed, it cannot be distinguished from potassium by ordinary chemical methods but can easily be identified by the spectroscope. It is malleable, and on a fresh surface has a silvery yellow luster. It has a melting point of 28.45 deg. C., and is rapidly decomposed by water, with an evolution of hydrogen. The specific gravity is 1.87. It is one of the strongest bases known. Only two commercial ores of cæsium are known—pollucite, a hydrous cæsium-sodium-aluminum silicate carrying from 30 to 36 per cent cæsium oxide, and certain types of lepidolite (lithia mica), which carry from a trace to as much as 0.75 per cent cæsium oxide. Only two known localities produce pollucite in commercial quantities: certain feldspar and mica deposits in the State of Maine, and much more sparingly with petalite in granite in the Isle of Elba. Pollucite is colorless, has a hardness of 6.5, a specific gravity of 2.9, is conchoidal in fracture, brittle, and has a vitreous to gum-like luster. Nothing is known as to the quantity, if any, secured from the Elba deposits, but it is estimated that a ton or more of the mineral was mined from the various deposits in the State of Maine during 1926 and 1927. The prices ranged from several dollars per pound up to as high as $15 per pound; but towards the end of 1927 the demand abated. The average cæsium content of all ore mined was probably about 15 to 20 per cent.

Cæsium offers a striking example of how an obscure and little-known element may become, as it were, famous overnight. Prior to 1926 it was regarded as a chemical curiosity, and the quantity available in the form of its salts could be measured in grams. Then the radio industry discovered that it had properties which made it a vastly important adjunct in the manufacture of radio "tubes." In the form of the chloride or nitrate it is mixed with magnesium or cerium metal and compressed into small tablets or "pills." These are introduced in the radio tube. At a certain stage in the evacuation process the pellet, or "getter," as it is called in radio parlance, is flashed, thus eliminating the last trace of air in the tube and securing the desired high vacuum. It is claimed that cæsium is much more efficient than any of the other "getters" heretofore used.

Cerium—Cerium metal is iron gray in color, with a brilliant, metallic luster. It has a specific gravity of 7, and when pure has a melting point of 623 deg. C. It forms alloys with iron, zinc, magnesium, and aluminum, and also combines with silicon and boron. This metal of commerce is really a mixture of cerium with other metals of the cerium group (such as lanthanum, praseodymium, or neodymium). This mixed metal is produced by the electrolysis of fused anhydrous chloride of cerium, obtained from cerium residues, produced in large quantities in the treatment of monazite sand for its thorium content.

The metal appears on the market chiefly in the form of its alloy with iron, variously known as ferrocerium, pyrophoric alloy, sparking metal or flint stones. Its most important commercial use is for ignition purposes—in gas lighters, pocket lighters, and other devices of a similar nature. As indicated by its trade names, it throws off copious showers of sparks on being filed or abraded. No important new uses were developed in 1927, although it is probable that considerably more of the alloy was consumed in 1927 than in the previous year, because of a renewed demand for pocket lighters.

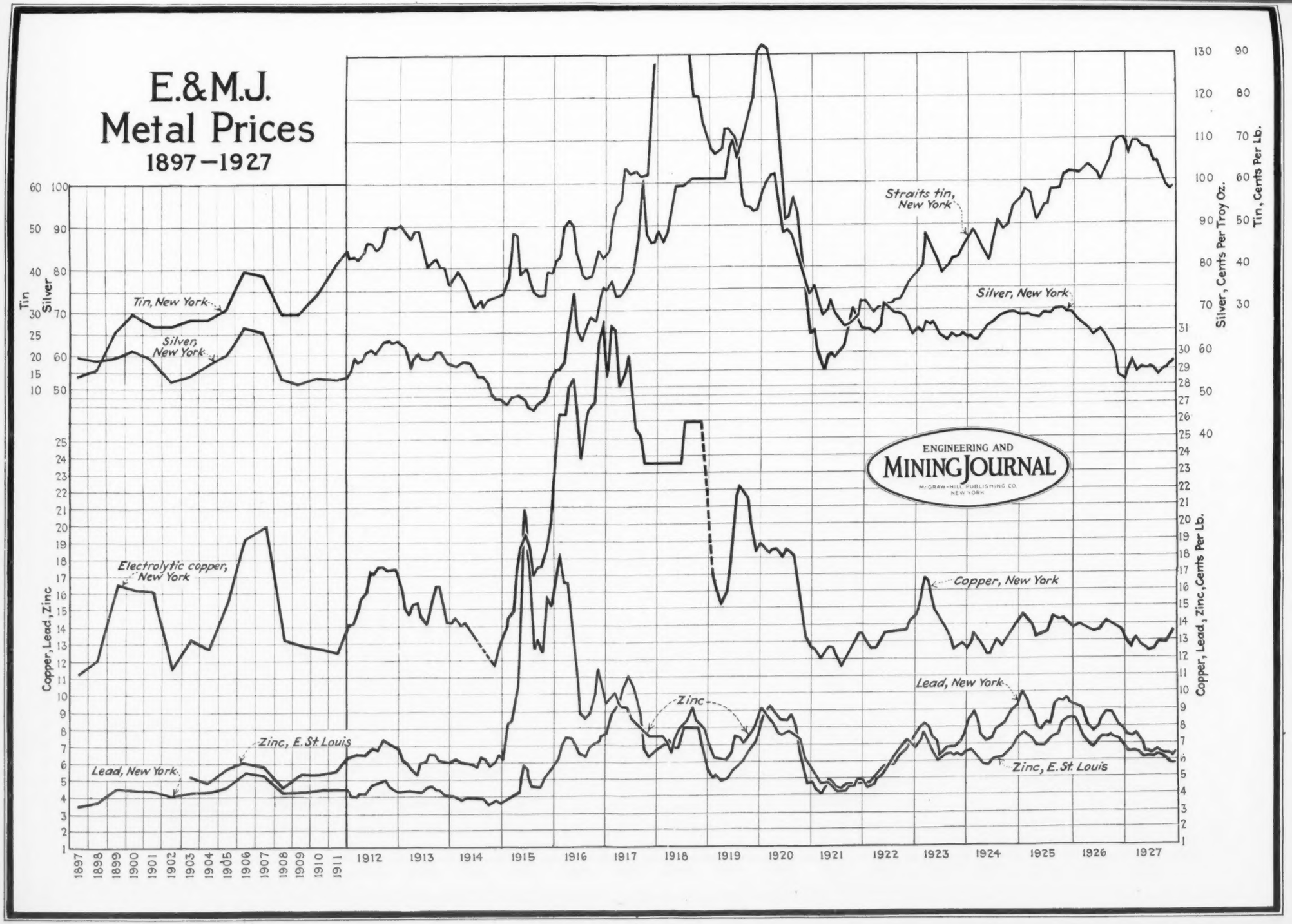
The price of the imported metal during the first half of 1927 was about $5.25 per pound. During the last half of the year an advance in price occurred, and good-sized lots sold at about 5.75 per pound. Cerium metal was in small demand and sold at about $3.75 per pound, duty paid, the price on material of domestic manufacture being somewhat higher. Small quantities of it went into the radio industry, where it was used in conjunction with cæsium salts.

Selenium and Tellurium—Although selenium and tellurium are closely related, physically and chemically, a real commercial use for tellurium has never been developed. The production of selenium is limited, and no ores of this element are known. Its chief source of supply is from the anode muds in the electrolytic refining of copper, where it is associated with tellurium. The principal use of selenium continues as a decolorizer in the glass industry, as well as in the production of ruby glass for decorative purposes, and in the production of red enamels. It appears on the market in black vitreous or amorphous form.

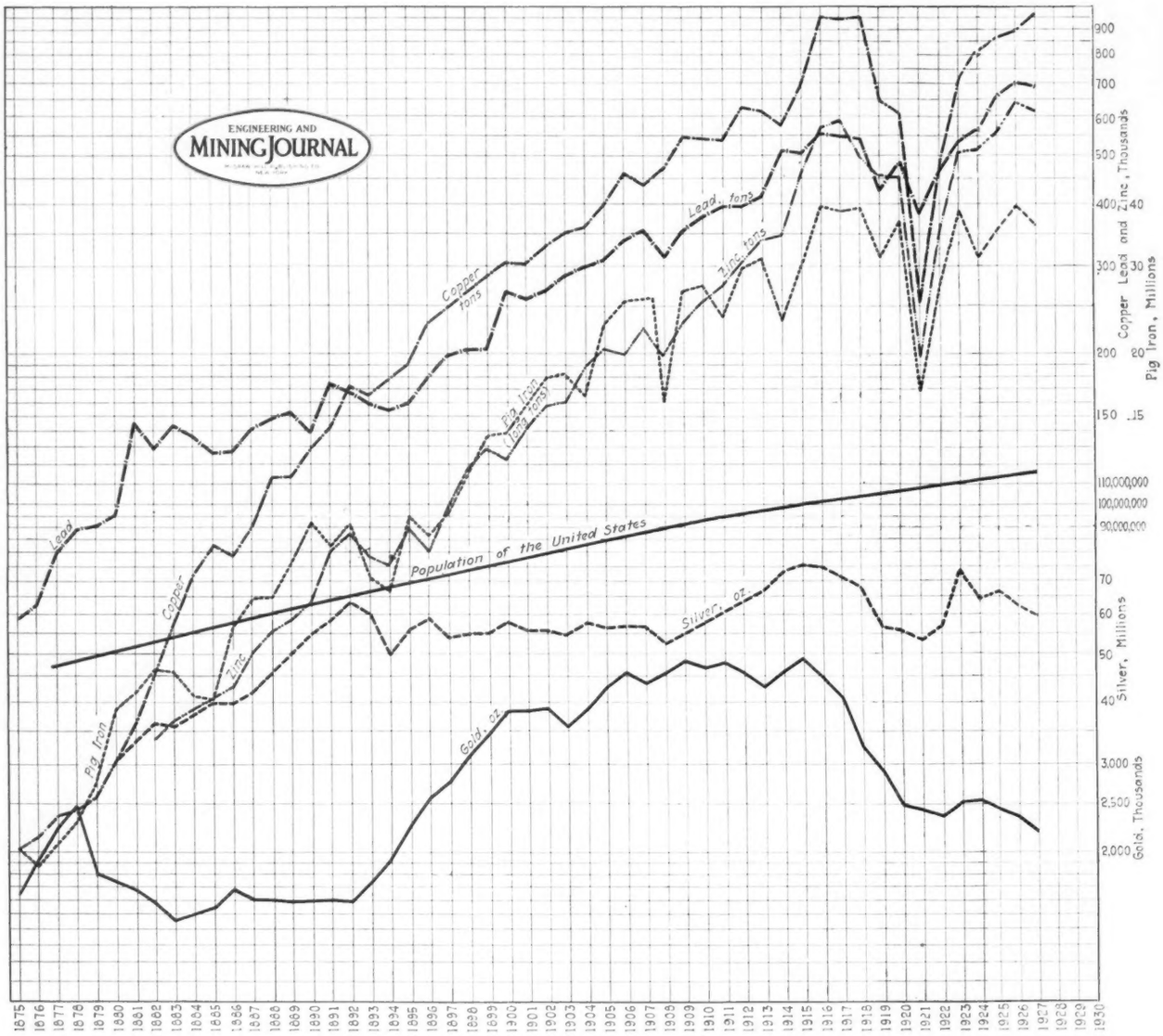
Selenium is also used in the rubber industry for increasing the toughness or wear-resisting qualities of rubber in sheathed wire cable; also in the manufacture of photo-electric cells, and selenious acid is a valuable reagent in the determination of zirconium. The United States is the principal producer. During 1927 prices remained stationary, at about $1.95 to $2 per pound. Small lots of imported selenium were available at about $1.90 per pound.

Thallium—The metal thallium resembles lead so closely in its physical and chemical properties that it can be distinguished from it only by chemical tests. It has a specific gravity of 11.38 and melts at 285 deg. C. No commercial ores of thallium are known. Production depends on extraction from flue dust from sulphuric acid plants and other smelting operations, where ores carrying small percentages or thallium are treated.

During the first half of 1927 the price of the metal was about $8 per pound; but, with increasing demand and a limited production, the price rapidly advanced, and by the end of the year the metal was selling for as high as $15 per pound. Almost all of the metal is converted


E.&M.J.
Metal Prices
1897—1927
Tin
Silver
Tin, New York
Silver, New York
Straits tin, New York
Silver, New York
Silver, Cents Per Troy Oz.
Tin, Cents Per Lb.
ENGINEERING AND MINING JOURNAL
McGRAW-HILL PUBLISHING CO. NEW YORK
Copper, Lead, Zinc
Electrolytic copper, New York
Copper, New York
Lead, New York
Zinc
Zinc, E. St. Louis
Lead, New York
Zinc, E. St. Louis
Copper, Lead, Zinc, Cents Per Lb.
1897 1898 1899 1900 1901 1902 1903 1904 1905 1906 1907 1908 1909 1910 1911 1912 1913 1914 1915 1916 1917 1918 1919 1920 1921 1922 1923 1924 1925 1926 1927

Metal Production of the United States, 1875 to 1927



Yearly Average Prices of Principal Metals, 1899-1927

Prices in New York or St. Louis, cents per pound, except quicksilver (dollars per flask); silver and platinum (dollars per ounce). London quotations, pounds sterling per long ton

	Copper		Lead		Tin		Zinc			Anti-mony,	Quick-silver,	Silver,	Plat-inum,
Year	Electrolytic New York	Standard London	New York	London	(b) New York	(a) London	New York	St. Louis	London	New York	New York	New York	New York
1899	16.67	.....	4.47	14.933	25.12	122.429	5.75	.....	.....	9.430	43.63	59.580	15.22
1900	16.19	.....	4.37	16.987	29.90	133.575	4.39	.....	.....	9.500	51.00	61.330	18.09
1901	16.11	.....	4.33	12.521	26.74	118.633	4.07	.....	.....	8.250	47.00	58.950	20.00
1902	11.626	52.460	4.069	11.262	26.79	120.720	4.84	.....	.....	6.120	48.03	52.160	19.00
1903	13.235	57.970	4.237	11.579	28.09	127.320	5.40	5.191	.....	6.000	41.32	53.570	18.91
1904	12.823	58.884	4.309	11.983	27.99	126.733	5.100	4.931	.....	6.371	41.00	57.221	19.50
1905	15.590	69.465	4.707	13.719	31.358	143.083	5.882	5.730	25.433	10.250	38.50	60.352	20.34
1906	19.278	87.282	5.657	17.370	39.819	180.646	6.198	6.048	27.020	21.730	40.90	66.791	28.04
1907	20.004	87.007	5.325	19.034	38.166	172.638	5.962	5.812	23.771	14.840	41.50	65.237	30.98
1908	13.208	59.902	4.200	13.439	29.465	133.124	4.726	4.578	20.163	8.004	44.84	52.864	16.32
1909	12.982	58.732	4.273	13.042	29.725	134.774	5.503	5.352	22.185	7.466	46.30	51.502	24.87
1910	12.738	57.054	4.446	12.920	34.123	155.308	5.520	5.370	23.050	7.386	47.06	53.486	32.70
1911	12.376	55.973	4.420	13.970	42.281	192.353	5.758	5.608	25.281	7.540	46.54	53.340	43.12
1912	16.341	72.942	4.471	17.929	46.096	209.420	6.943	6.799	26.421	7.760	42.46	60.835	45.55
1913	15.269	68.335	4.370	18.743	44.252	201.679	5.648	5.504	22.746	7.520	39.54	59.791	44.88
1914	13.602	61.524(c)	3.862	19.076(c)	34.301	156.564(c)	5.213	5.061	22.544(c)	8.763	48.31	54.811	45.14
1915	17.275	72.532	4.673	22.917	38.590	163.960	13.230	13.054	67.533	30.280	87.01	49.684	47.13
1916	27.202	116.059	6.858	31.359	43.480	182.096	12.804	12.634	72.071	25.370	125.49	65.661	83.40
1917	27.180	124.892	8.787	30.500	61.802	237.563	8.901	8.730	52.413	20.690	106.30	81.417	102.82
1918	24.628(d)	115.530	7.413	30.100	(e)	330.138	8.159	7.890	54.180	12.581	123.47	96.771	105.95
1919	18.691	90.796	5.759	28.590	63.328	257.601	7.338	6.988	42.879	8.190	92.15	111.122	114.61
1920	17.456	97.480	7.957	37.832	48.273	295.866	(e)	7.671	44.372	8.485	81.12	100.900	110.90
1921	12.502	69.356	4.545	22.752	28.576	165.265	(e)	4.655	25.845	4.957	45.46	62.654	75.03
1922	13.382	62.123	5.734	24.097	31.831	159.450	(e)	5.716	30.003	5.471	58.946	67.521	97.618
1923	14.421	65.840	7.267	27.147	41.799	202.148	(e)	6.607	33.058	7.897	66.502	64.873	116.537
1924	13.024	63.149	8.097	34.421	49.674	248.727	(e)	6.344	33.728	10.836	69.761	66.781	118.817
1925	14.042	61.920	9.020	36.429	56.790	260.974	(e)	7.622	36.624	17.494	83.128	69.065	119.093
1926	13.795	57.971	8.417	31.075	63.615	291.016	(e)	7.337	34.105	15.988	91.903	62.107	113.269
1927	12.920	55.653	6.755	24.192	62.747	288.953	(e)	6.242	28.513	12.393	118.159	56.370	84.636

(a) Prices of tin, London, from 1899 to 1914 from statistical report of Metallgesellschaft, Frankfurt-am-Main. (b) 99 per cent tin. (c) Average for nine months, no quotations being made during August, September and October. (d) Average of eleven months, no quotations being made in December. (e) No average computed.

into its salts, such as the sulphate, nitrate or acetate. The United States and Europe are the two principal producers.

The most important use for thallium is as a poison for rodents and ants. It is claimed that it is superior to arsenic, strychnine, or phosphorus, being tasteless and odorless. It therefore does not arouse the suspicion of the rodent. Large quantities of it are used on the Pacific Coast in controlling ground squirrels and gophers. The sulphate, of course, is mixed with food attractive to the rats or other rodents. It is a cumulative poison, but is certain in its results.

Less important uses of thallium and its salts are in photoelectric cells and for medicinal purposes. The so-called Clerici solution is a mixture of thallium formate and malonate. It has a density of 4.4 to 4.65, and is used for determining the specific gravity of minerals.

Titanium—More and more attention is being paid to locating and developing deposits of titanium ore. The stimulus has been the development and the extension of uses of pure titanium oxide as a pigment. The only two commercial sources of titanium are rutile, the natural oxide, and ilmenite, an iron-titanium oxide. Although there are numerous occurrences of rutile throughout the world, only a few deposits are of economical importance, one in Virginia and the other in Scandinavia. Deposits in Australia have been worked from time to time. Ilmenite is a much more abundant ore than rutile, and occurs in massive form as well as in the form of sand. Some deposits of ilmenite in massive form are found in Canada and Scandinavia. Ilmenite, in the form of the black sand, has been recovered from the electro-magnetic treatment of Brazilian monazite sand, as well as from similar deposits of monazite near Travancore, India.

Massive ilmenite carries from 35 to 45 per cent titanium dioxide. Ilmenite sand carries from 48 to 55 per cent titanium dioxide. As ilmenite is much more plentiful and a cheaper ore than rutile, it is favored by manufacturers of ferrotitanium and titanium oxide or titanium white.

The pure white pigment, titanium oxide, is marketed as titanalba, titanox, and titanium white. Careful laboratory tests on titanalba have shown that it is distinctly superior in many respects to white lead, lithopone, or zinc white. It is characterized by high obscuring power, great covering capacity, fastness to light and heat, excellent elasticity, and is unaffected by sulphur compounds, acid fumes, or alkalies. As many foreign countries have very stringent laws prohibiting the use of white lead in any of its forms for interior painting, titanium oxide forms an excellent substitute, as it has no poisonous properties. It also produces excellent white enamels, is a rust preventive, and is not affected by salt air or water. It requires about 23 per cent of linseed oil to grind to a stiff paste. The uses of this pigment are rapidly increasing, and many tons of it are consumed annually in the manufacture of white paints and enamels. Smaller quantities are used in lithographic and printing inks, and also in the rubber industry.

The pure oxide also appears on the market blended with blanc fixe (precipitated barium sulphate), to which in some cases is added zinc white to improve its drying qualities. Prices of the blended product ranged from 10c. to 25c. per pound, depending on the content of titanium oxide. The pure oxide, which contains 99 per cent TiO_2 or more, ranged in price in 1927 from 28c. per pound to 40c., depending on quantity.

Titanium was also used in the form of its ferro-alloy as a deoxidizer or scavenger in the iron and steel industry. The natural oxide or rutile in prepared form is used as a ceramic pigment. These uses, however, are now subordinate to its application as a pigment.

Prices of ilmenite and rutile were steady throughout 1927. Ilmenite sand sold in carload lots for about $17 to $20 per ton and carried a minimum of 50 per cent TiO_2. Massive ilmenite carrying a minimum of 40 to 45 per cent sold for much lower figures. Rutile, either Norwegian or Virginian, sold in carload lots for about 12c. or 13c. per pound.

Zirconium—No important new uses for zirconium or its products were developed in 1927. Its use as a refractory body in the form of the natural oxide (zirkite) or silicate continued to grow, and the rather deep-rooted prejudices of the refractory industry are slowly being overcome as its remarkable properties as a heat resisting body become better known. The two important ores of zirconium are the natural oxide, sold under the trade name of zirkite, and the silicate or zircon. The only commercial deposits of zirkite known at present are those in Brazil, near Poços de Caldas, in the State of São Paulo.

Zirkite appears on the market in several grades, carrying 65 per cent to 90 per cent zirconium oxide. Standard zirkite averages 75 per cent or more ZrO_2. Zircon is obtained by the concentration of monazite sand, large deposits of which are found in Brazil and India.

The price of zirkite in carload lots in finely powdered form was firm throughout 1927 at about $50 per ton. The price of zircon ranged from $60 to $80 per ton, in carload lots. Pure oxide of the mineral brought from 35 to 50c. per pound.

It has been recently determined by laboratory tests that almost all zirconium minerals contain the newly discovered element hafnium, the chemical properties of which are closely related to those of zirconium.

Tripoli

By G. V. B. Levings
Resident Manager, American Tripoli Company, Seneca, Mo.

THE tripoli business for 1927 recorded an appreciable increase over 1926, the total having amounted to 14,000 tons, in round figures. This increase was again fairly well distributed through domestic and export business, decided improvement having been shown in England and on the Continent.

The continuance of short-term buying has been noticeable in this as in other lines, with the result that the range between high and low months is lessening. Taking the average monthly shipments as 100 per cent, the difference between the high and low month for 1926 was 40.9 per cent, having come down from an average of 144.6 per cent for the four years 1920, '21, '22, and '23. This figure for 1927 is 39.94 per cent.

No new uses of consequence were developed during the year. The bulk of the production continues to go to the metal trades, approximately 60 per cent to the foundries and 30 per cent to the metal finishers.

Antimony

By K. C. Li
President, Wah Chang Trading Corporation, New York

WORLD production of antimony in 1927 was slightly less than the previous year, but consumption was a great deal less, the reasons for the former being the uncertainty and lack of consuming demand and resultant declining prices.

China, the dominating producing factor, produced at least 90 per cent of the world's output in 1927, and heavily at the beginning of the year, which naturally caused the price to decline; but the Nationalist movement drive, started from Canton and now controlling the Yangtze Valley, passing through the antimony-producing district, curtailed production and did some good. Political and economic conditions in China continue unsettled and affect the antimony market, as seen in increased cost of production due to increased labor costs and the difficulty in financing, producing, shipping and delays in communication. The price of antimony would undoubtedly have been lower in 1927 but for the fact that the cost of production in China was materially increased by the formation of labor unions and increases in wages. Also, the export tax was and may be still further increased.

The lessened demand for antimony may be attributed, first, to the decrease in the use of batteries for radio sets —almost all battery plates contain antimony. With the introduction of various new electric and electrified radio sets, the demand for batteries fell off considerably. Second, the demand for bearing metals containing antimony was also poor, owing to the general curtailment of business. These reasons, together with the complete shutdown of the Ford plant for nine months, were the important factors in making conditions in 1927 unsatisfactory.

The antimony market, following two strong years since the war, opened in 1927 with a price of 12¾c. per pound, duty paid, f.o.b. New York, and reached a high for the year in the latter part of April, when the market was quoted at 15½c. per pound, duty paid. Little activity occurred during the spring and summer months, and the market gradually eased off and sold at the low point for the year in the latter part of September, when spot antimony sold as low as 10¼c. per pound, duty paid. The market improved slightly in the latter part of 1927, and early in December the market for spot was quoted at 11¼c., duty paid, with the outlook better for higher prices.

The market activity of antimony during 1927 was sympathetic with that of its associate metal, lead. In previous years, antimony was more actively traded in by dealers and importers. Also, in past years, on account of the scarcity of the metal, consumers generally covered their commitments several months ahead, on account of the length of time it takes antimony to reach destination from China. At present, consumers (most of whom are pursuing a hand-to-mouth buying policy) do not contract for future shipments from China, as was customary; instead, they are only buying spot or near-by definite deliveries. This method of purchasing has added an additional burden to the importers and dealers who have to hold the bag for the consumers. The lack of trading activity in 1927 was undoubtedly due to the fact that most of the regular importers and dealers found it unprofitable to trade in antimony, the price of which fluctuates more than that of any other metal, with the possible exception of tin. It is one of the most difficult markets to gage, as so many factors have to be considered in establishing market value.

Now that the new Ford car is officially announced, with production to be probably tripled each month from this month, and with lower production of antimony from China, I shall be surprised if a considerably higher market for this metal is not reported in 1928, even though it is the Presidential year.

Cobalt

By G. C. Bateman
Secretary, Ontario Mining Association, Toronto, Ontario

OUTPUT of cobalt ores during 1927 showed little change compared with 1926. The low-silver high-cobalt ores in 1927, as also in 1926, comprised a small part of the production, almost all the metal, oxides, and salts coming from the high-grade silver ores and concentrates of the Cobalt camp—the only source of supply on this continent. These ores are refined in Canada only by the Deloro Smelting & Refining Company; but, in addition, a considerable tonnage of cobalt residues was shipped to Germany from the high-grade plant of the Nipissing company.

The only production figures available are those of cobalt metal combined with the metal content of oxides, salts, and unseparated oxides. The Ontario figures for the first nine months of 1927 show 617,940 lb., valued at $1,246,158, compared with 572,581 lb., valued at $950,033, for the corresponding period of 1926.

No change occurred in the price paid for the raw ore by the Deloro company, which continues at 2c. per unit per pound of ore carrying 5 per cent or over in cobalt. That is, an 8 per cent ore would be worth 16c. per pound of metal contained, or $25.60 per ton. A stronger demand was in evidence for ore from outside sources, inquiries coming from the United States, England, and Germany, but chiefly from Germany. These inquiries call for a high-cobalt low-silver ore, and sales have been made on the basis of $90 per ton for 8 per cent ore, $100 for 9 per cent, and $110 for 10 per cent. Although these are much higher prices for cobalt than those quoted above, they do not provide payment for silver. Ontario silver producers, however, have a favorable smelting rate. They are paid for a high percentage of the silver, and find it better to sell their combined output of silver and cobalt ores on contract, as the cobalt is only a byproduct. Supplies of high-cobalt, low-silver ores, aside from these sources, are limited, so that exports are chiefly residues, the tonnage of raw ore exported being small.

The output of cobalt metal and salts is controlled by the African and Ontario producers, who also control to a large extent the available raw materials. Nominal quotations are $2.50 per pound for metal and $2.10 per pound for black oxide. It is, however, understood that substantial reductions from these prices are offered to steel companies, in an effort to increase consumption. Much research has been carried on with this in view, and a growing consumption of the metal in the manufacture of magnets is reported, the cobalt increasing the magnetic permeability. The use of stellite, an alloy of cobalt, tungsten, and chromium, is increasing, the alloy being welded on to parts subject to great abrasion. This is now being used for the top of grizzly bars and on fishtail bits for churn drilling.

Quicksilver

By H. W. Gould
Mills Building, San Francisco

QUICKSILVER during 1927 brought the highest prices recorded for the full period of a year. Production in the United States was possibly 20 or 25 per cent over the recorded production of 7,642 flasks for 1926. The price rose from about $100 per flask a year ago to $130 towards the end of 1927, with a strong possibility of higher prices during 1928. World production continues to increase and will probably reach nearly 115,000 flasks for 1927. Rising consumption will probably carry it above the highest pre-war consumption within the next few years.

The greatest increase during 1927 was at the Almaden mine, in Spain, from 21,000 flasks in 1921, to about 52,500 for the season that closed on July 1, 1927. This is almost exactly the production, in the same period, of the combined Italian mines. The Monte Amiata district slightly increased its production, whereas the Old Idria mine, in the Trentino (formerly in Austria), has declined. A question of importance is whether or no the Spanish government will increase the output at Almaden during 1928. A change of management in 1927 was responsible for alterations at the mine, but it has been reported that a bad cave on the lower level has greatly hampered operations and caused the depletion of high-grade reserves held in the upper levels for many years. For this reason, it has been rumored that the Almaden mine does not look as promising as it has heretofore, and some European engineers doubt if production can be greatly increased in the next year or two.

In the United States, more activity has occurred in the industry than at any time since 1916. Many of the old mines are being reopened, many new prospects found and developed, and several new plants installed. However, little increased production is reported as yet. It takes time to reopen an old property, install a plant, and build up a working organization. As usual, the New Idria is the largest producer, with the Chisos mine, in Brewster County, Tex., probably second. In California, during 1927, the Oceanic, Cloverdale, Aetna, Oat Hill, Knoxville, and Sulphur Bank all made considerable production, with new furnace plants installed at the Knoxville and Sulphur Bank.

In Oregon, the Blackbutte mine, at Cottage Grove, installed a 4x60 ft. rotary furnace. The Mercury Mining Company, near McDermott, installed a 4-ft. rotary, and the Pacific Quicksilver, near Prineville, installed a 2x24 ft. rotary. All three have started producing. In Arizona, the old Sunflower mine now has a 4x60 ft. furnace plant, and produced in 1927. One or two other smaller properties will probably produce in 1928. In Nevada, considerable activity is noticeable in all the quicksilver-mining districts, particularly near Mina, in the Fishlake district, West of Coaldale; at Beowawe; and near Lovelock, at which point the Pershing quicksilver mine is installing a 4x60 ft. furnace, and will probably soon be in production. In Washington, the Barnum-McDonnel property, near Morton, is the largest producer, working Johnson-McKay retorts and doing well.

Consumption of quicksilver seemed to keep pace with production in 1927, and will probably continue to do so throughout 1928. Increases in consumption seem to be more pronounced in the electrical field than elsewhere—electric signs, storage batteries, and recording instruments leading. It has been reported that the General Electric Company is putting in a new 20,000-kw. mercury boiler power plant at Hartford, Conn. If many such are erected, the demand for quicksilver will be greatly increased.

For 1928, I expect to see a considerably augmented production in the United States and Mexico; and, generally, a prosperous year for the quicksilver industry.

Asbestos

By Norman R. Fisher
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THOUGH full particulars of 1927 operations are not yet available, it is apparent from those already to hand that the output of the Canadian asbestos industry will be much the same as that for 1926 in terms of tonnage, but considerably higher in terms of value.

The output of asbestos for 1926 was a record, and the average value was high enough to provide a substantial margin of profit. It is evident that 1927 will prove to have been an unusually prosperous year for the industry.

The following table, giving the quantity and value of the asbestos shipped in the period 1922-26, inclusive, shows how the industry has grown and improved its position in respect to prices by the elimination of price cutting as a result of the merging of competitive interests.

Year	Tonnage Shipped	Total Value	Average Value	Recovery Per Cent
1922	160,339	$6,053,068	$37.75	5.10
1923	216,804	7,364,260	33.97	5.82
1924	208,762	6,561,659	31.37	6.20
1925	273,322	8,976,645	32.82	6.63
1926	278,689	10,095,487	36.22	6.02

During 1927, twelve mines were in operation, six of them in the Thetford district, one at Black Lake, one at Coleraine, two at East Broughton, and one, the largest single operation of all, at Asbestos, near Danville.

The Johnson company, of Thetford, which in the past has confined its operations mostly to the production of crude, brought into production during the year a fiberizing mill having an estimated capacity of about 25,000 tons of fiber per annum. The Asbestos Corporation has rehabilitated the Vimy Ridge mine at Coleraine, remodeling its mill in keeping with current practice, and has under way the installation of another large mill at Thetford, this time on its Beaver property, at an estimated cost of $1,500,000. Preparations are also being made to install a small mill on a property near Danville, in which it is proposed to demonstrate on a commercial scale the claimed advantages of the wet method of recovering asbestos.

Conditions in the industry outside of Canada are more or less normal, with production about the same as in 1926. Rhodesia will have produced in 1927 about 36,000 tons, worth, on the average, about $110 per ton; and the Union of South Africa, about 15,000 tons, worth about $75 per ton.

Cyprus is gradually improving its position, and in 1927 produced about 10,000 tons, worth, on the average, about $100 per ton; and Russia produced about the same quantity, of problematical value. Italy and the United States are also producers, but only to the extent of about 2,500 and 1,500 tons, respectively, as are also, in an even smaller way, China, India, and Australia.

Tungsten

By Frank L. Hess
Chief Engineer, Rare Metals and Non-Metallics Division, U. S. Bureau of Mines, Washington

PROBABLY the most striking feature of the American tungsten market in 1927 was its flatness. Whether this, like some other market features, was due to the closing of the great Ford auto plant is uncertain.

During the first eleven months of the year the United States produced and sold an equivalent of 1,101 short tons of concentrates carrying 60 per cent WO_3. The estimate for December was 105 tons. The increase in stocks held by producers was 147 tons, so that the total production for 1927 was 1,353 tons, containing 1,287,700 lb. of tungsten and valued at $740,936, as against 1,383 tons produced in 1926.

Imports for the first eleven months of the year contained 1,549,242 lb. of elemental tungsten, equivalent to 1,628 short tons of 60 per cent concentrates and valued at $294,681. If imports continued through 1927 at the same rate, the total would be 1,775 tons, the entry value of which would be about $321,470 ($3.08 per unit). The duty, 45c. per pound of contained tungsten in ore, amounting to about $7.14 per unit (about 232 per cent) would be about $760,537. As a matter of fact it was somewhat higher, because some tungsten came in as powder, as ferrotungsten and other alloys, and met a higher duty, making the total probably close to $800,000. Tungsten (elemental), such as in ores and alloys, held in bond on Dec. 31, 1926, was 2,261,984 lb., and on Oct. 31, 1927, it was 1,406,450 lb., a decrease equivalent to 899 short tons of 60 per cent concentrates.

Owing to the duty, tungsten ore and products are not ordinarily entered for consumption until the importing company is ready to use the ores, so that, apart from the use of domestic scrap and scale, the consumption is closely indicated by the sum of imports, withdrawals from bond, and domestic sales, and would seem to have been close to 4,000 short tons of 60 per cent concentrates. Some foreign tungsten-bearing scrap was imported during the year, but other tungsten-bearing scrap had been held up since 1925 on the contention that it should be subject to a duty as tungsten steel. The test case was made on turnings from steel carrying 14.5 per cent tungsten, fit only for remanufacture, and sold for less than 7c. per pound. The tungsten content was not guaranteed by the seller. The Collector of the Port of New York decided it was enterable as scrap steel, but the Board of General Appraisers in 1925 decided that it was dutiable "as a compound of tungsten." The Court of Customs Appeals reversed the lower court in a decision published April 21, 1927.

Domestic prices ranged from $10.25 to $10.75 per short-ton unit (20 lb.) of WO_3 for Chinese wolframite, and from $10 to $11 for domestic scheelite. Ferrotungsten ranged from 87 to 95c. per pound of contained tungsten.

The Massachusetts-Nevada Company at Mill City, Nev., was the principal producer in 1927; Alex Ranson also worked a scheelite vein near Mina. The Tungsten Products Company, 20 miles northwest of Bishop, Calif., was busy mostly with development work. The Atolia Mining Company worked through lessees, but did the milling for them. Effective work was done in simplifying milling practice. Residual placers were worked for a time with a gas-electric shovel; but when, in the summer, prices fell to $10 per unit, work ceased. In South Dakota, the Homestake Mining Company worked wolframite ore carrying a little gold. In Boulder County, Colo., the Wolf Tongue Mining Company, Tungsten Production Company and several smaller companies produced ferberite. In Missouri a little wolframite was produced near Fredericktown; and in Arizona a little huebnerite was produced from the placers north of Dragoon, and a small quantity of scheelite from the southwest side of the Huachuca Mountains.

The governing price for the reduction of tungsten ores was that set by the Electrometallurgical Company, of Niagara Falls, 20c. per pound for the contained tungsten in ferro carrying 80 to 85 per cent W, with a guaranteed recovery of 92 per cent. This price and guarantee applied, of course, only to pure ores. Those with interfering elements naturally met a higher cost. Recoveries actually may exceed 95 per cent.

As is fairly well known, some scheelites carry molybdenum. During the year the U. S. Bureau of Standards experimented with ferrotungsten, carrying 85.08 per cent tungsten and 4 per cent molybdenum, manufactured from such ores. Steel containing 18 per cent tungsten and 0.75 per cent molybdenum and 16 per cent tungsten and 0.75 molybdenum, respectively, showed as well under test as similar steel without molybdenum.

Late in 1927 a movement to increase the duty on tungsten was started, as well as an agitation for a lowering of the duties. Little is known of foreign production. China still dominates the world's tungsten market, and most American imports were from that country. India exported 538 long tons of tungsten concentrates during the first three months of 1927, but they were largely from Mawchi, and carried only 20 to 25 per cent WO_3. The shipments for the quarter were probably equivalent to about 190 short tons of 60 per cent concentrates. The ore was mined with cassiterite, and it is said that no mining was done for tungsten alone. The Malayan districts also made some concentrates as a by-product of tin mining. Some of the Chinese ore imported carries tin, and it has been found cheaper to trans-ship the ore to England, have it cleaned, and reship it to New York than to have the work done in the United States.

Diatomite

By Paul D. V. Manning
Chemical Engineer, South Pasadena, Calif.

PRODUCTION of crude diatomaceous earth and its fabrication into finished products in 1927 was equal to or greater than in 1926, which was a good year. Exact or even approximate figures of production are not available, owing to the reticence of the producers. Government bureaus are also unable to furnish statistics.

The establishment of an efficient and complete research laboratory with a staff of more than thirty men by the largest producer on the Pacific Coast, and the carrying out of a large amount of systematic research on production and uses, have done much to increase the demand for finished products, notably as an additive to concrete mix, where it is meeting with constantly increasing favor because of increase of workability and evenness of set. Prospects for 1928 are good.

Radium, Uranium, Vanadium

By Frank L. Hess
Chief Engineer, Rare Metals and Non-Metallics Division, U. S. Bureau of Mines, Washington, D. C.

IT IS still unprofitable to work uranium deposits for radium and uranium in the United States, although some ore carrying 4 to 8 per cent U_3O_8 is extracted in southwestern Colorado and southeastern Utah, for sale to the companies making radioactive drinking water, salves, complexion preparations, and pads for rheumatic and other ailments.

Belgium, in its possession of the Katanga deposits, still rules the radium market. The sales of the Union Minière du Haut-Katanga remain at about 20 grams of radium a year, which retails at about $70,000 a gram. The same company naturally controls the greater part of the market for uranium salts, which find use in colored glass and pottery, and also in giving a creamy tint to building tile. About 28,000 lb. of uranium pigments for glass and ceramics are made annually.

No radium was produced in Czechoslovakia in 1926, the works having been shut down in order to enlarge and improve the plant. Mining was continued, however, and 22 short tons of pitchblende carrying 50 per cent U_3O_8 was produced. It was expected that the radium production for 1927 would be about 3 grams, though when completed the plant would have a capacity of 6 grams. In Portugal three concessionaires were operating radium mines and concentrating works, but little is known of results.

Although the Vanadium Corporation of America has the largest and richest known vanadium deposits, near Cerro de Pasco, Peru, and ships much ore, which carries a far larger precentage of vanadium than is found in the American ores, competition is active in the United States; the development of vanadinites and related minerals in South Africa, which can be put on the market carrying 10 per cent of vanadium, has added to the competition. A constant threat is implied in the fact that vanadium can be produced from titaniferous iron ores.

Imports into the United States of vanadium-bearing ores during the first eleven months of 1927 were 6,174 short tons, valued at $557,139. Most of the ore was from Peru, and carried between 11.75 and 12 per cent vanadium. The U. S. Vanadium Corporation, a subsidiary of the Union Carbide & Carbon Corporation, continued the mining and milling of the vanadium-bearing sandstone on East Rifle Creek, near Rifle, Colo. The ore carries roscoelite (vanadium mica) and vanoxite (hydrous vanadium oxides), or minerals so near them that they cannot be distinguished by ordinary microscopic methods. Considerable improvements were made in the mine, buildings, and reduction plant at Rifle. Fused vanadium oxide is made from the ore and shipped to the company's plants at Columbiana, Ohio, and Niagara Falls, N. Y., for the manufacture of ferrovanadium.

The U. S. Company of New Jersey did little at its mines and concentrating plant in Dry Valley, near Moab, Utah, but it made fused vanadium oxide at Denver from the concentrates produced in 1926. During 1927 the company acquired claims on West Elk Creek, near Newcastle, Colo., covering a deposit said to be similar to and in the same geologic horizon as the deposits of the U. S. Vanadium Corporation which is only a short distance away. A carload shipment carried 5.40 per cent V_2O_5 (3.02 per cent V). The company also acquired the Calamity, Maverick, Outlaw, and Flat Top groups of claims, formerly held by the Radium Corporation of Colorado, in the Gateway district of Colorado, and two groups of claims in Long Park, 56 miles west of Placerville. The company has another mill in contemplation, at some more convenient location, at which it will work over piles of vanadiferous sandstones saved by miners of carnotite. With only two producers, no figures for American production may be given.

Some vanadinite from Ahumada, Mexico, was reduced by the Vanadium Corporation of America; and the Electro Metallurgical Company has from time to time smelted the vanadinites and related minerals from South Africa. There is as yet, however, no general market for the vanadinites.

Shipments from the Peruvian mines in 1927 were about the same as in 1926. Vanadinites and related minerals have been shipped continuously from South Africa, especially from the region of Otavi; and it appears that the production will continue. Europe is supplied with almost all of its needs from this source.

The Rhodesia Broken Hill Development Company, Limited, at Broken Hill, Rhodesia, according to a report issued in February, 1927, has developed processes for the extraction of vanadium from its zinc ores, has applied for patents, and expects to produce annually 630 tons of ferrovanadium carrying 34 per cent vanadium.

Use of vanadium in steel is apparently increasing, in spite of competition from molybdenum and from the more careful treatment of steels. Also, the use of fused vanadium oxide as a catalyst in various organic and inorganic syntheses now absorbs monthly one or two thousand pounds of fused vanadium oxide carrying more than 90 per cent V_2O_5.

Feldspar

By Frank P. Knight
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SALES of ground feldspar during 1927 are estimated as about 215,000 tons. Probably 65 per cent of the total came from fourteen mills owned by six of the larger producing companies. The remaining 35 per cent was distributed among fifteen other grinding mills, or an average of about 4,600 tons each. Grinding capacity has been further increased as a result of changes in some of the existing plants. New construction has been restricted because it was found, after investigtaion, that the field was overcrowded.

Competition continued to increase, and the average price realized became lower during the earlier part of 1927. Having become too close to production costs, price conditions were somewhat more stable during the latter half of the year. Operations on the whole, it is believed, have been unprofitable. The consumer has demanded an ever better product and has received it at a lower cost. This is not a healthy condition. Adjustments will have to be made; better prices must be realized or costs reduced.

Crude feldspar was in plentiful supply throughout 1927, and stocks are believed to have been larger than at the close of 1926. Prices have held well. Approximately 12 per cent of total crude came from Canada and 88 per cent from within the United States.

Manganese

By Charles Hardy
President, Charles Hardy, Inc., New York

IMPORTS of manganese in 1927 were the same as in 1926, in spite of reduced activity in the steel industry. Up to the end of September imports from all countries amounted to 263,460 tons manganese content in ore, or at the rate of 340,000 tons per annum, compared with 347,000 tons in 1926. Yet the situation is by no means unchanged or as favorable as these figures would indicate. The reported reduction of use of manganese per ton of steel produced is not correct, yet when the steel industry is operating for most of the year at 60 to 70 per cent capacity, the consumption is much curtailed and manufacturers of ferromanganese or the consumers thereof find themselves with an appreciable tonnage on hand to carry them into 1928.

The buyer and user of manganese ore has stocks on hand; and the main producing centers, India and the Caucasus, have mined far in excess of sales. India is reported to have sold only 600,000 tons, against a production of 1,200,000 tons; and the Caucasus, although no exact figures are available, has also not been able to place anything like its production; 1928 begins, therefore, with an accumulated tonnage, which I believe will undoubtedly work toward a lower level of prices. As a matter of fact, during the latter part of 1927, a cargo of Indian ore was handled at a price not heard of since the Great War.

If supply and demand, and not the control of the producing fields, were alone the determining factors, the price would now be much nearer the pre-war figure. The known manganese deposits of the world—mainly of India, Brazil, Caucasus, and the West Coast of Africa—can well take care of the world's demand, even at a greatly increased steel consumption; yet new deposits, as those in South Africa and Australia, are being developed and give promise of a great future.

This increased foreign production and the prospect of lower prices has again brought into prominence the question of duty on manganese ore. Domestic producers have formed an association to protect their interests and are carrying on active propaganda to bring their point of view before the trade; yet, tariff or no tariff, they, with but few exceptions, will find it difficult to maintain their position if the anticipated price reduction on foreign ore takes place. Domestic ore is produced in the far west, and is of a lower manganese content, so that the freight east to the consumer per unit of manganese absorbs a great deal of the advantage that might be gained by the duty.

The main producing countries of high-grade manganese are not consuming countries to any extent; hence the United States, England, Germany, France, and Belgium, the largest steel producers of the world, have to rely on importations. England can draw on deposits in India, South Africa, and Western Australia; the other countries must rely on imports from foreign countries, where they may have financial but not political control. No wonder that efforts are being made in many quarters to develop a domestic supply and to adopt scientific methods to utilize hitherto unsuitable ore; or to turn such ore, as for instance rhodochrosite, into high-grade concentrate and ferromanganese.

The treatment of rhodochrosite has progressed in Montana, and the developments there will bear watching. The total deposits of this grade, or of any kind of manganese ore suitable for the steel industry in the United States, are not sufficiently large or developed to provide an appreciable tonnage of this country's needs; and for a long time to come reliance must be placed on imports from abroad. As a matter of fact, the imports of steel-grade ore in 1926 had a manganese content of 347,000 tons; whereas the total domestic production amounted to 26,530 long tons—which is not even 3 per cent of the imports.

Consumption of chemical and battery-grade manganese ore is showing a steady growth, Montana supplying the bulk of the United States requirements, supplemented by imports of Caucasian and Java dioxide ore.

The import figures for 1927 are available only for the first nine months. A table, as supplied by the U. S. Bureau of Mines, will be found on p. 110 of this issue of *Mining Journal*.

Bismuth

By Hamilton M. Brush
Vice-President, A. S. & R. Company, New York

THE bismuth market continues its uninteresting course. The English syndicate made only one change in price in 1927, from 10s. to 8s. on April 1, the higher figure having been in effect from March 2, 1926.

Practically the only development of interest in the market during 1927 was the increase in United States production, which for the first time has made this market independent of foreign supplies and the duty (7½ per cent) of value to American producers. This increase in American production arises, not because of the discovery of bismuth ores, but through the development of further and more intensive Cottrelling and baghouse treatment of lead ores, resulting in a larger recovery of bismuth as a byproduct. Recognizing this situation, the largest American producer reduced its price for bismuth on July 1 below the European parity, plus duty. For many years the American price has been uniformly the European price, plus duty, and each year the entire American production has been disposed of at this parity; and, in addition, certain imports of foreign bismuth have been necessary to supply this market. In 1925, for instance, the government reported imports of approximately 100,000 lb.; in 1926, 67,000 lb. No government figures are yet available for 1927, but from trade reports it would seem that the imports for 1927 would not exceed 20,000 to 25,000 lb. Presumably, these imports will continue to decrease in view of the fact that the American producers are unquestionably able to take care of the entire United States consumption.

So far as can be ascertained, the consumption of bismuth is continuing with little change in either direction. No new uses have been discovered; its use in medicinal salts and cosmetics continues to furnish the chief outlet.

As in the past, little or nothing is known of the European situation. The syndicate publishes no data as to production, stocks on hand, or consumption. The general feeling is that consumption is increasing satisfactorily outside of the United States, but that supplies, actual and prospective, are ample to take care of requirements.

Sulphur and Pyrites

By Raymond F. Bacon
Chemical Engineer, Chemists' Building, New York

PRODUCTION of sulphur in 1927 will probably show a substantial increase over that for 1926, and it may be expected that the total production will be somewhat less than the total shipments. Shipments indicate that the United States consumed about 50,000 tons less than in 1926; but, even so, it shows a considerable increase over 1925.

The fertilizer industry for the year ended July 1, 1927, sold a little over 85 per cent of the amount sold the year before; and this, together with the fact that the carry-over of acid phosphate from 1926 into 1927 was large, resulted in a decrease in the consumption of sulphur.

Apprehension was felt early in 1927 as to the effect of the great capacity for pulp and paper production. However, considering the pulp and paper industry of the United States and Canada as a whole, the sale of sulphur to that industry was almost the same for 1927 as for 1926. Mills did not operate at full capacity as they had done in 1926; but, collectively, the consumption of sulphur was almost the same. It is taken as a sign of the sanity and good judgment of the industry that it has not allowed the situation to become demoralized. Hope is expressed that, by growth of consumption of pulp and paper, the large production may be absorbed and a healthy condition continue to exist in that industry.

The manufacture of acids for chemicals or for sale to consuming industries was almost the same in 1927 as for 1926. It is difficult fully to explain this situation when it is remembered that the steel industry was somewhat slack for most of 1927. One possible explanation is the treatment of larger quantities of petroleum products.

Although the sale of sulphur in 1927 only slightly exceeded that of 1926, a review can merely show that the sulphur industry, and therefore business as a whole, was satisfactory during 1927. Probably the weakest division was the fertilizer industry.

The use of pyrites has not materially increased—disregarding the copper-bearing pyrites and other sulphide ores that are converted at the mine into sulphuric acid, as for example in the Ducktown district. California is the largest producer of pyrites in the United States. It is estimated that the imports will be slightly less than those of 1925, so that in all probability the consumption of pyrites by the United States will not be much greater than that of 1925. Imports and production in 1926 were larger than in any year since 1920.

America continues yearly to export larger quantities of sulphur; 1927 will see exports of about 750,000 tons, the largest in the history of the American industry. This is in part due to difficulties encountered by the Sicilians in maintaining production and to the restoration of Europe to a better industrial basis. Total shipments of sulphur from Sicily in 1927 were about 240,000 long tons. Canada continues to be the largest foreign market, with France and Australasia second and third, respectively.

From all indications, 1928 should be a good year. The fertilizer industry is proceeding with a careful program of manufacture and sales, and may be expected to consume not less than it did in 1927 and probably considerably more. The acid industry, for chemicals and for general consumption, will depend largely on general business conditions in the steel, oil and automobile industries. It is thought that these industries will be prosperous during 1928.

The export market should continue at about the rate of 1927, perhaps increasing as manufacturing becomes more stable. On p. 110 of this issue will be found tables giving the estimated consumption of sulphur and pyrites for 1927.

Gypsum

By Frank A. Wilder
North Holston, Smyth County, Va.

ALTHOUGH the gypsum industry prospered in 1927, tonnage figures will probably be somewhat smaller than those of the preceding year. New plant and equipment, which totaled not less than $5,000,000 in value in 1926, added materially to the capacity of the industry in 1927. Competition was keener, and lower prices for all gypsum products prevailed.

Crude gypsum mined in the United States in 1925 totaled 5,678,302 tons, according to the U. S. Bureau of Mines, and this may stand as the high figure for some years to come. Production in 1926 was 42,861 tons less than in 1925, or less than 1 per cent of the total output. The value of gypsum products in 1926 was about 2 per cent less than for the preceding year. The shrinkage in tonnage of gypsum mined in the United States in 1927 may be from 3 to 4 per cent, compared with 1926, and the decrease in value of gypsum mined from 6 to 7 per cent.

Production of gypsum in Canada increased 143,405 tons, or nearly 20 per cent, in 1926 over 1925, and over 15 per cent in value. Almost all this came to Atlantic Coast points from Nova Scotia. A similar increase in output of Nova Scotia gypsum will doubtless appear when figures for 1927 are tabulated. The plants of the Atlantic Gypsum Products Company in New York and at Portsmouth, N. H., are new factors in the industry, and use Nova Scotia gypsum as raw material. The tonnage for 1927 for these plants will doubtless show an increase, even though the New York City mill of the company (formerly owned by the Rock Plaster Company) was burned in October. Steps to rebuild it were taken immediately.

In January, 1927, the Southern Gypsum Company, of North Holston, Va., allied its interests with the Beaver Products Company, which already owned several gypsum mills. The new corporation is known as the Beaver Products Company of Virginia. The gypsum wall-board industry continues to expand, largely at the expense of fiber boards, though in a smaller measure it affects the production of gypsum plasters. Dry gypsum plaster as an insulator was the only gypsum novelty put on the market in 1927. This is poured between studs and rafters as a fire retardant as well as an insulator. Investigations of gypsum-anhydrite mixtures as retarders for portland cement were continued during 1927 by the gypsum and the cement industries, with results generally favorable for such mixtures when used with the ordinary types of cement-mill clinker.

Chromite

By Edward Sampson
Princeton University, Princeton, N. J.

WORLD chromite mining had a year of prosperity in 1927. Over 300,000 metric tons was mined, and the total may be close to the 1926 record of 350,000 tons. Of this amount, Rhodesia supplied about 210,000 tons, and the United States imported about the same amount. This is 60 per cent of the world production, which shows the relative status of Rhodesia and the United States in this respect.

The sources of chromite have varied in recent years. Although the deposits are widely distributed, few are high grade or large. However, it appears that the Rhodesian industry is firmly established, and that mines in other parts of the world must meet the conditions imposed by Rhodesia. The large production there in 1926 and 1927 is in part due to temporary demand. In 1925 the railway from the chromite fields to Beira was washed out and shipments were curtailed. The trouble recurred in 1926. In 1927 no interruption occurred and consumers in the United States have now accumulated large stocks. For this reason a lessened demand is sure to follow in 1928.

Baluchistan for a time loomed large in the chromite trade, but it is reported that the deposits are now seriously depleted. However, shipments in the first half of 1927 were 10,000 long tons, as compared with 14,500 for the same period in 1926. Baluchistan supplies the European market. Greece continues to furnish an important part of the refractory ore to the American market, 21,000 long tons being imported in the first ten months.

Imports by the Bethlehem Steel Company from Cuba decreased in 1927. New Caledonia furnished from 25,000 to 30,000 tons, largely to the European market. In recent years Turkey has produced no chromite; but, when political conditions warrant, the Smyrna region can be counted on to supply a considerable amount of the ore.

Platinum developments in the Transvaal have resulted in a considerable production of chromite, some of the platinum being directly associated with it. However, in most of such occurrences in the Transvaal the chromium content is low, and in the ore with over 45 per cent Cr_2O_3 the iron is extremely high. Great difficulty has been found in selling such ore in the United States. The supply of low-grade chromite ore seems to be large.

Before the war, much of the chromite for Europe came from the Urals. Russian ore is again a strong factor in the European market. The extent of the chromite of northwest Montana is still uncertain, but a large supply of high-grade ore has been reported in that region.

A well-informed member of the chromite industry estimates the consumption in the United States in 1927 as follows: ferrochrome, 46 per cent; refractories, 41 per cent; chemicals, 13 per cent. In the last five years the chemical market has not kept pace with the rate of increase in amount of chromite used for ferrochrome and refractories. The outlook for 1928 discloses the prospect of a world demand for chromite that will be about equal to the consumption in 1927.

Nickel

By Thomas W. Gibson
Deputy Minister of Mines, Toronto, Ontario

THE mines of the Sudbury district, Ontario, are the preponderating source of the world's supply of nickel, and these were active during 1927. Production of nickel-copper matte at Copper Cliff and Coniston, based on the figures for the first nine months, amounted to 83,000 tons, containing 40,000 tons of nickel and 26,500 tons of copper. This compares with 45,886 tons of nickel and 23,843 tons of copper in 1918, the peak year of war production, and 39,038 tons of nickel and 24,158 tons of copper in 1926. Most of the matte was refined at the International Nickel Company's works at Port Colborne, Ontario, the remainder being exported to the United States and Wales. At Huntingdon, W. Va., the International company produces Monel metal and malleable nickel. The Mond company operates a similar plant at Clearfield, N. J. The Mond company, at Clydach, Wales, turns out refined nickel and sulphate of copper.

All the International ore was taken from the great Creighton mine, where, during 1927, a four-compartment incline shaft was raised and timbered from the 30th to the 20th level, and sinking is proceeding below the 30th. It is the intention to install a hoist for this shaft in a station cut on the 20th level. The Mond company's ore supply came from the Levack, Garson, and Worthington mines; also a little from the Frood Extension. The Worthington mine caved in on Oct. 4, and was almost destroyed, but without loss of life. Considerable ore remains in the mine.

In the Frood mine, estimated to contain at least 100 million tons of ore, the diamond drill has revealed the existence of a large body of rich copper ore, at a depth of between 2,000 and 3,000 ft. Part of the orebody is owned by the International and part by the Mond, the dividing line between the properties of the two companies running across the deposit. The drill cores assayed 23 per cent copper and 1.5 per cent nickel, with platinum and palladium. Probably two years will elapse before this ore can be mined, but the result will probably be that the companies will then be more concerned with copper than with nickel. Additional smelting and refining facilities are being planned to handle this ore on the property.

Three blast furnaces are now in operation at each of the works, as well as a reverberatory furnace at Copper Cliff. The sulphuric acid plant at Coniston was operated at full capacity throughout 1927.

In New Caledonia, Société le Nickel and Société des Hauts-Fourneaux continued nickel mining. Exports up to the end of August amounted to 2,909,891 kilos of matte, which went to France, Belgium, and the United States. The New Caledonian ores contain no copper, the proportion of nickel in the matte being from 75 to 78 per cent.

Metallic nickel and nickel alloys continue to find an expanding market, a new use being in electric refrigerators, for each of which about 20 lb. or more of nickel is required. The greatest use of nickel is as an alloy, particularly in nickel steel. On the whole, the status of the industry was well sustained during 1927, and steady progress continues to be made that will have a favorable effect on future developments.

Molybdenum

By B. F. Phillipson
President, Climax Molybdenum Company, New York

THE market for molybdenum continued to increase during 1927, despite the lower production of automobiles. Numerous new consumers of steels containing the metal as an alloy became regular users. Molybdenum is now used in steel rarely by itself, but usually in conjunction with chromium in the chrome-molybdenum forging grades of steel; with chromium and nickel in the chrome-nickel-molybdenum types used for such parts as gears and die blocks; and with nickel alone in the nickel-molybdenum case-hardening steels used in the manufacture of roller bearings, differential gears, and other carburized parts. The use of the metal in both steel and iron castings likewise increased somewhat during 1927.

Mining operations were continued. An exhaustive program of diamond drilling and development work was carried through at Climax, Colo., where the largest known deposit of the metal is located, between twenty and twenty-five million tons of ore having thus far been blocked out there. Larger mining and milling operations resulted in lower costs, which made it possible to reduce the price of the metal for 1928 delivery by about 20 per cent.

Although a steady growth is reported in the consumption of the metal, both here and abroad, the total world market is still far less than the productive capacity, and the trend is toward continually lower prices as the market expands and permits of lower production costs.

Kaolin—White Clay

By R. T. Vanderbilt Company
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SHIPMENTS during 1927 of china clay and ball clay were larger than during the previous years. Domestic production will probably show an output from 550,000 to 575,000 short tons, with about 450,000 short tons imported. This will make a total of over 1,000,000 tons for combined shipments. The business is on a highly competitive basis, with overproduction here and abroad, and sales have been made on a basis showing a small margin of profit and none at all on some of the lower grades of imported clay from England and on cheap domestic grades.

The clay producers in England have recently reformed their association, with almost all mines included, and have announced an increase in prices for 1928 amounting to about $2 per ton on the lower grades, where the price basis has been particularly low, and small increases on higher grades. The domestic grades are now so competitive among themselves, however, that this will have little effect on the price at which American production will be sold.

During 1927, no important discoveries of new grades were reported. The outstanding event was a merger of the largest producers of ball and sagger clays in Kentucky and Tennessee. Use of domestic ball clays has been growing, because of the increased demand for ivory-color dinner ware, at the expense of both English china clay and ball clay. The larger part of dinner ware being made in the Sebring and East Liverpool districts is ivory.

A new mine and refining plant started operations in Florida in 1927, and is producing clay of standard quality. A new bleached or chemically treated clay is being sold to the paper manufacturers at a higher price and in competition with some of the better grades. This is a step in the right direction toward improving the quality of domestic production. A grade of pyrophyllite from North Carolina has also been put on the market and has interesting ceramic possibilities. Pyrophyllite has an analysis similar to clay and is remarkable for its low iron content and freedom from impurities.

The production of American clays has shown an increase in volume for several years past, notwithstanding the low prices prevailing. This is largely due to the efforts of the miners to reduce costs by larger production and the readiness with which output may be increased. It is expected that 1928 will bring a normal increase if general business conditions continue steady.

Nitrate

By Lester W. Strauss
Mining Engineer, New York City

THE Chilean government in 1927 was much concerned in regard to its income from the nitrate export tax. In the latter months of 1926 and the first four months of 1927 a depression in the industry coincided with a deadlock between the government and the Nitrate Producers Association, the former refusing to consider any reduction of the export tax and the latter any reduction in selling price. The depression can be best understood from the fact that in February, 1927, only 23 oficinas, out of 149, were operating, and few on full time. The workers were shipped to the south and the industry was approaching a standstill. By Oct. 15 about 46 oficinas were again in operation and 12,000 men had been shipped back to the north. At the close of 1927 it was expected that 60 oficinas would be producing.

In February, 1927, the nitrate output was 70,000 metric tons; and by the close of December the monthly rate was 200,000 tons. Exportation was low up to June; from June 15, to Oct. 15, 836,000 tons was exported; and in the succeeding months, as much as 260,000 tons per month. The sales during the period June 15 to Oct. 15 have been estimated at 2,250,000 tons. Free sales began in April. Prices varied from 16s. 3d. early in June, to 18s. 2d. per 100 kilos, alongside of ship, duty paid, early in November.

The Guggenheim process at Oficina Maria Elena commenced in November, 1926, the corporation being now the premier nitrate producer in Chile; it also operates two Shanks-process oficinas. During the early part of 1927 the Prudhomme process was expected (in some quarters) to be applied successfully, but this did not materialize. The Banthein process is equally incapable of being carried to a commercial outcome, in the opinion of technologists of broad operating experience.

Leaching with cold water, without the heating of solutions, in continuation of the excellent work done at Oficina Alemania in 1926, has entered another phase. A modification of metallurgical heap leaching is being tried; solar evaporation of the resultant liquor is practiced, the crystals being purified by dissolution in hot solvent and re-crystallization. A process has been developed by Paul Holstein and S. H. Loram. Similar trials were made at Oficina Renacimiento, in the Aguas Blancas pampa.

Fluorspar

By G. H. Jones
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THE U. S. Bureau of Mines reports imports on fluorspar every month. Up to Oct. 31, 1927, an increase of about 10 per cent occurred over 1926, and 1926 was a record year of imports. The increase has placed an additional burden on United States producers, and they have been obliged to lower prices enough to hold buyers' interest. A shutdown of the leading mines would be expensive and destructive, and they have operated during 1927 at a loss. Inasmuch as all consumers are almost on the same price basis, f.o.b. mine, no advantage could be taken of a higher price where foreign competition could not be encountered. On the lower level of prices, unprofitable as they were, leading mines were able to make fair production. Such a condition, however, cannot continue, nor should it be expected; a profit, even if a small one, must be made to justify continuance.

The hope of the industry is in the granting of its petition to the U. S. Tariff Commission for a maximum increase in duty under the flexible provision of the Tariff Act of 1922. Hearings were held by the Tariff Commission on July 22 and 23, 1927, many producers being present, with little opposition from consumers. Although progress in such matters is usually slow, fair progress has been made, with the hope that the Tariff Commission will be able to present its findings to the President for an early decision.

The year 1927 opened with a minimum price of $18 at mines for washed gravel, guaranteed analysis of 85 per cent and over in calcium fluoride and not to exceed 5 per cent silica, but in view of the facts heretofore stated, prices became gradually weaker and ended the year at $16, f.o.b. mine. No properly equipped mine can exist at this price and take care of proper charges for maintenance, renewals, depreciation, depletion, exploration, and development work.

The probable output for 1928 depends largely on the consumption of the steel companies, whose operations during the latter part of 1927 have been sub-normal, with the expectation, however, that much better conditions will prevail in 1928. Without the tariff relief asked for, the fluorspar industry will continue in a very unsatisfactory condition, with the survival of the fittest as the logical outcome.

Salt

Editorial Summary

LITTLE more than an estimate can be made of the production of rock salt for the year 1927 until after the publication of government statistics. Information available as to production indicates a decrease of 10 per cent as compared with 1926.

Consumption in connection with ice for refrigerating purposes was affected by the coolness of the summer and the introduction of mechanical refrigeration by the ice-cream industry in drug stores and ice-cream parlors, and to a lesser extent on account of the use of carbon dioxide "snow." The chemical and miscellaneous industries used about the same amount as in 1926.

For the five-year period ended December, 1925, the general trend of consumption was upward, especially east of the Mississippi River. Since then the trend has been downward. This may be checked and possibly reversed if the general level of freight rates on salt is made to accord with the low value of rock salt, thereby increasing its use as a raw material and for commercial purposes.

No changes were noted in methods of mining and preparation of rock salt during 1927. The labor situation has been somewhat easier, but this has not resulted in any decrease in wages, nor has it increased the prosperity of the producers. The industry is characterized by over production. There are more mines in the southern section, the central-western section, and the northeastern section of the country than are needed for any requirements that can be foreseen for many years. Consequently, competition is severe and prices are extremely low. Rock salt is a low-priced commodity—the price f.o.b. mine averaging less than the freight to principal points of consumption. Therefore, the freight rate is a matter of great importance.

Some producers have sold considerable tonnage in markets at a long distance from their mines, in competition with mines close to these markets. This is possible because the distant producers have substantially the same rate for a vastly longer haul. Producers taking advantage of this situation have used distant markets as a dumping ground, and this has been the principal cause of the present demoralized salt prices.

Tantalum

By Paul C. Kerk
J. Bishop & Company Platinum Works, Malvern, Pa.

THE CLOSE of 1927 marked the introduction of tantalum in a variety of forms for industrial and laboratory use. This new metal has several valuable characteristics, including resistance to chemical attack, strength, and comparatively low cost.

The discovery of tantalum dates back to the early part of the nineteenth century. Credit for first obtaining metallic tantalum, in 1824, belongs to Berzelius. Little could be done with it, however. Its separation was difficult, and it was found impossible at that time to fabricate it. During the first few years of the twentieth century advances were made in the art, but only within the last few years has pure ductile tantalum been obtainable. Because of its ready oxidation at low temperatures, the manipulation of tantalum had been difficult, although means to overcome this have been perfected. Its rapid absorption of gases, particularly hydrogen, make the metal brittle and extremely hard. In manufacturing, it is therefore of primary importance that it be protected from gas absorption at each stage. The specific gravity of tantalum is 16.6; the melting point 27.70 deg. C. Its tensile strength in pounds per square inch is 130,000. Tantalum becomes blue at a temperature of about 400 deg. C., and nearly black at a somewhat higher temperature. Above a dull-red heat, a white oxide is produced, and the metal gradually burns. It combines readily with oxygen, nitrogen or hydrogen. It can absorb 740 times its own volume of hydrogen.

A summary of the uses and commercial applications of tantalum will be found in a subsequent issue of *Mining Journal*.

Magnesite

EDITORIAL SUMMARY

DOMESTIC producers of caustic calcined magnesite are confined to California. Although there are now only two or three principal producers, foreign competition from magnesite originating in Greece and India is an important factor in the Atlantic seaboard market, which under favorable conditions absorbs enough caustic calcined magnesite to enable the California companies to mine sufficient tonnage to spread their overhead. In recent years, foreign competition has increased and has resulted in reduced domestic production. The possibility of a third competitor, Margarita Island, off Venezuela, made the situation gloomier. However, the domestic producers late in 1927 obtained a 50 per cent increase in the tariff of $12.50 per ton. As a consequence, the year closed with better prospects of an increased market for the domestic producers. Part of the domestic production in 1927 was diverted in the form of dead-burned magnesite, which found an eastern outlet. On the whole, domestic production of caustic calcined magnesite will be less than in 1926. Importations aggregated somewhat less than 10,000 tons.

Two principal companies produced dead-burned magnesite, one in California and the other in Washington. The Washington production will be about the same as in 1926. Imports of dead burned reached an estimated total of about 54,000 tons, derived principally from Austria and Czechoslovakia. A small amount of crude magnesite was imported from Canada, Greece, Germany, British India, and the Netherlands.

No important technological developments are reported. The future for caustic calcined of domestic origin appears to be improved, and greater production is expected for 1928. Dead-burned magnesite will probably remain in its present status, the bulk of the demand being satisfied from foreign countries and the domestic producers dividing the remainder. Potential resources of magnesite have received no special increment, as conditions did not warrant prospecting efforts.

Potash

BY C. H. MACDOWELL
President, Armour Fertilizer Works, Chicago

DURING the last twenty-five years almost every nation has searched for an independent supply of potash. The World War intensified the search, and schemes to develop potash from lake brines, leucite, alunite, greensands, distillery waste, flue dusts, and ashes were promoted, some with success. But in 1927 German and Alsatian deposits supplied 95 per cent of the world's requirements, valued at $100,000,000. Germany, with a present valued investment of nearly two billion marks, produced over 1,200,000 tons and consumed 700,000 tons. Alsace produced 380,000 tons, the United States 28,000, Poland 15,000 and Spain 25,000. It is estimated that Germany has enough potash to supply the world for over 2,000 years at the present rate of consumption, and Alsace for several centuries. Germany has over 200 mines, of which 43 are in operation and 22 in immediate reserve. In spite of this enormous production reserve, three new possible sources of supply are in prospect: The waters of the Dead Sea in Arabia, which, according to a recent report, are to be exploited by responsible English capitalists; potash deposits in the Ural Mountains in Russia; and the known potash deposits in western Texas and eastern New Mexico.

The year 1927 was a satisfactory one from a producer's viewpoint, both as to tonnage and price. Tonnage has increased about 20 per cent, and prices for the first time since the war have been on a higher basis than pre-war. Potash prices in the United States for 1927 were about 12 per cent higher than in 1926, and ranged from 1½ per cent, on bulk salts, to 12 per cent, on sulphate, higher than pre-war. The world's consumption of potash has increased since 1913 by over 45 per cent, principally in Germany, France, Japan, Scandinavian countries, Holland and England. Consumption in the United States has increased only 6 per cent. The small country of Holland uses about one-third as much potash as the whole United States, its consumption being about 23 lb. of K_2O per acre. Germany uses over 20 lb. per acre; the United States, less than 1 lb. per acre.

About 10 per cent of domestic requirements were produced in the United States. The largest factor, at Trona Lake, California, with the help of its byproduct, reports a satisfactory year, with prospects of increased production in 1928. The second largest producer, at Baltimore, producing 3,500 tons of K_2O from distillery waste, has found a market for its output. It is reported that private capital is interested in developing potash deposits in Midland County, Tex., where workable veins have been found at a depth of about 2,000 ft. However, the district is handicapped by long land hauls to ports and to interior potash-consuming sections, and must secure decidedly favorable rate treatment if it is to compete successfully with foreign sources of potash supply.

Barytes

BY S. W. THOMPSON
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BARYTES ore is a basic requirement in several lines of manufacturing, and the derivatives therefrom have increased in use largely during the last ten years. The largest tonnage of barytes ore is used in the manufacture of lithopone; then come the various barium salts, such as barium carbonate, barium chloride crystals, barium sulphate (blanc fixe), barium hydroxide, barium nitrate, and barium sulphate (natural). Each of these divisions carries specific uses for which the byproduct is adapted; and the growing necessity for these various salts, as well as the major portion of the tonnage which is lithopone, will demand a constantly increased production of crude ore.

Production of crude barytes ore in 1926 was as follows: Algeria, 800 tons; Australia, 2,500; Austria, 1,500; Canada, 100; Bavaria, 2,500; Prussia, 170,243; Italy, 35,000; Spain, 10,000; United States, 248,685 tons.

Figures for 1927 crude-ore production no doubt will show at least a 10 per cent increase in the United States over 1926.

The division of the total tonnage of crude barytes ore in the United States is about as follows: Lithopone, 164,693 tons; ground barytes, 52,851; barium salts (combined), 31,141 tons. The ratio will probably not

change greatly, except as the increase in the use of lithopone augments the consumption of crude ore for the finished product.

The virgin deposits of barytes ore in the United States will last for many years. Indeed, there is one producer who has identified orebodies surveyed, measured, and marked out to last twenty years, at an extraction rate of 60,000 tons a year. In various states deposits of barytes ore are surveyed, but, for reasons of distance from railroad centers, will remain undeveloped until required. Georgia produces about 40 per cent of the total amount, Missouri producing about 45 per cent, the remainder of the states producing the balance now mined in the United States.

The future of the barytes industry, as it affects the American producer, can only be harmed by a lowering of our present tariff, as the parity between the ordinary wages paid in this country and those paid in foreign countries is so wide that any downward change in the present tariff would ruin the domestic industry. Today the standard for merchantable ore is so much higher that vast sums of money have had to be expended for equipment in order to produce this higher grade of ore, and no opportunity offers for lowering costs from the present rate. An American industry that has grown to the magnitude represented today by this industry and its manufactured adjuncts needs protection and must have it.

Talc

EDITORIAL SUMMARY

AT GOUVERNEUR, N. Y., a new talc mine is being opened up and will produce in 1928. A deposit of soapstone and talc is being opened up in the Riggins district, northern Idaho; a promising deposit of talc has been disclosed at the Ganim mine, in northern California, and a contract has been closed for supplying agents in the San Francisco Bay region; near-talc (pyrophyllite) properties in North Carolina are said to be producing more than in 1926.

Inexperienced operators are continually breaking into the talc industry, but remain only long enough to exhaust capital and create a disturbance in the market. New talc mines will not yield a substantial tonnage increase in 1928 unless in the hands of experienced miners and distributors.

At least one important company has established a research laboratory and is investigating new uses, one of which is for rock dusting in coal mines. An increase will occur in the employment of short-fiber talc for various purposes where an inert filler is needed, as for concrete conditioning, paints, rubber, and the like.

Production for 1927 will probably not show any considerable increase above that of 1926, as prices have not been especially remunerative. However, producers in the Eastern states, by close economy, have been able to make a profit on lower grades. Few produce any of the higher-grade white talcs such as are produced in California.

Imports for the first eight months of 1927 were smaller than in 1926, the respective amounts being about 11,500 and 16,000 tons. Much of the imported talc competes in the high-grade talc markets and thus more directly affects the California producers. Foreign producers have the advantage of cheap labor, cheap freight, and a long-established market in conservatively operated industries. Co-operation in sales effort by California producers would be an advantage. Canadian talcs are marketed in the East and Middle West, where low freight rates prevail and where quality is less important than cost delivered. California producers, owing to foreign competition and high freight rates, are at a disadvantage; they must compete in a widespread market. Their position would be improved if tariff protection, based on selling price to the user and not on price paid by the importer, could be obtained.

Aluminum

BY J. R. D. HUSTON
Aluminum Company of America, Pittsburgh, Pa.

THE domestic production of aluminum was greater in 1927 than in 1926. Imports in 1927 continued heavy; during the first nine months, 60,355,425 lb. of crude aluminum was imported, compared to 54,371,560 lb. in the same period of 1926. In the same period of 1927, 374,999 lb. of plates, bars, and similar shapes was imported, compared to 38,998 lb. in 1926.

During the first nine months of 1927, 2,549,579 lb. of crude aluminum was exported from the United States, compared to 497,530 lb. during the same period of 1926. Exports of fabricated material in the first nine months of 1927 comprised 8,898,201 lb., compared to 7,202,433 lb. in the same period of 1926.

Work on the plants of the Aluminum Company of Canada at Arvida, in the Saguenay River Valley, Canada, has continued, and much aluminum was produced there in 1927. In the United States, two important dams are under construction, one on the Yadkin River and one on the little Tennessee River, both in North Carolina. The purpose of these is the storing of water and regulating the flow of the rivers, so that the power available for the aluminum works in that district will be equalized. On the completion of these dams, in 1928, it is thought that the difficulties arising in the past from droughts will be largely avoided. New aluminum works are under construction in France, Scotland, Norway, and Italy. Those in Spain began operations in November.

The use of aluminum in airplanes and seaplanes is constantly increasing, and many all-metal planes were built in 1927 in which almost all the structural parts were composed of aluminum alloys, and the hull and wings covered with aluminum or aluminum-alloy sheet. An interesting development in the aluminum industry was the production of Alclad sheet, which is a strong alloy-aluminum sheet protected by a coating of high-purity aluminum and designed for use when the sheet is exposed to corrosion.

Aluminum furniture is rapidly finding a market; it is fireproof and combines lightness with strength. The use of aluminum in the transportation field is steadily developing. During 1927, many railroad passenger coaches and street railway cars and buses were manufactured, in which aluminum was used to a great extent, with a saving of from 15 to 40 per cent in weight. The use of aluminum shingles and roofing material is increasing, as is also the use of aluminum castings and sections for structural and architectural work, foil, and for the manufacture of paint pigment.

The domestic quoted price of aluminum ingot, 99 per cent pure, remained at 27c. a pound until Jan. 15, 1927, when it became 26c., at which price it remained until Oct. 20, 1927, when it became 25c. a pound.

Graphite

By Benjamin L. Miller
Lehigh University, Bethlehem, Pa.

THE GRAPHITE industry of 1927 in some sections showed slight improvement, although without decided changes. Prices and production remained fairly steady, and indications point to a continuance of such conditions for some time to come. This is in sharp contrast to the condition that has existed during the last decade, during which period the abnormal demands of the war resulted in unusual expansion, to be followed by disastrous demoralization. A further decline in the use of graphite for crucibles is expected, but the increased use of the material in the electrical field may more than counterbalance the decrease.

In the United States in 1927 a greater activity was in evidence than in 1926. Three plants in Alabama are reported to have been in operation part of the year, although the total production for 1927 will not amount to more than a few hundred tons. Most of the product has gone to graphite manufacturers in Chicago. The Southwestern Graphite Company, in Texas, furnished considerable material for the electrical industry.

The only new development of consequence in the domestic industry was the building and equipment of a new plant at Annandale, N. J., by the Annandale Graphite Corporation. That company produced some graphite in 1927, but the difficulties incident to a new mill prevented it from making as much finished graphite as had been planned.

Madagascar still leads the world in graphite production. The quantity produced in 1927 was less than that for 1926, owing largely to the incomplete restoration of the transportation facilities, seriously damaged by destructive storms. A consolidation of the companies into larger units is taking place, and this should tend to greater stabilization. About one-third of the output has been coming to the United States, the balance being distributed among England, France, Germany, and Italy.

Production in Ceylon in 1927 was greater than in 1926. Up to Oct. 18 the increase in exports was 18 per cent in comparison with the preceding year. Exports to Germany were more than doubled, and still more came to the United States, whereas Great Britain received less than half as much as in 1926.

Few changes occurred in Mexico. Three companies operated during the year. The Canadian industry continued normal.

Fewer fluctuations in prices in 1927 were noted than for several years. Madagascar flake, with a carbon content of 82 to 85 per cent, sold in New York, duty paid, for from 7½ to 8c. per pound. Domestic flake commanded about the same price, with the exception of that produced in Texas which sold for somewhat less. Including duty, Ceylon lump sold in New York for 8 to 9c. per pound, chip for 7 to 8c. and dust for 3 to 5c. Only a small amount of Ceylon dust now reaches the United States.

Phosphate

By H. D. Ruhm
Mount Pleasant, Tenn.

THE Tennessee phosphate field during 1927 saw no active development of new properties and no putting into operation of new processes; so that from the standpoint of production, it may be said to be in the same status shown in last year's report.

The mines of companies that are subsidiaries of large fertilizer concerns were in fairly steady operation throughout the year, producing mixed lump and fines for their own and for competitive fertilizer manufacturing plants, and lump phosphate for the blast-furnace production of ferrophosphorus, for the electric-furnace production of phosphoric acid and phosphorus compounds, and for the furnace trade making high-phosphorus foundry iron.

Two of these fertilizer subsidiaries have erected mills for fine grinding; and, one directly and the other through a subsidiary, have entered the trade supplying ground phosphate rock to farmers. One, the largest independent mine operator, has deflected almost its entire output to a company that has been supplying ground phosphate rock for direct use for 30 years. The other independent operator, already in this trade, is at full capacity.

Independent operators who have no grinding plants continued inactive throughout 1927. The largely increased production of Morocco has taken a still larger slice of the Florida business heretofore going to Europe; and the consequent increased surplus of Florida for the United States market has made greater inroads on the consumption of Tennessee rock by the fertilizer-manufacturing trade. Only the considerable increase of phosphate for furnace consumption and as ground rock for direct use has kept the total output about on an even keel, so that 1927 shows about 450,000 tons consumed from Tennessee—about the same average as since 1923.

Several electric furnace and pyrolitic processes for the production of phosphoric acid direct from phosphate rock, using mine-run material, are rapidly nearing perfection, and the comparatively near future will see the installation of large plants of this type, producing concentrated super-phosphate, ammonium phosphate, and phosphate of potash in anticipation of the coming era of high-analysis complete fertilizers, such as nitrophoska and similar compounds already produced in Germany.

Several state experiment stations are beginning to further the direct use of finely ground phosphate for direct application to the soil and for animal feeding, to replace the bone products becoming scarce and high priced.

With those developments, the phosphate-rock industry in Tennessee will witness a period of extreme activity that will convert the 140 millions of tons of phosphate rock in the Tennessee fields from its present state of "frozen" assets into most active "liquid" form.

Prices at the end of 1927 were as follows per long ton, f.a.s. or f.o.b. mines: *Florida,* pebble, f.a.s., for export: 76@77 per cent, $7; 75 per cent, $6.25; 74@75 per cent, $6; 70 per cent, $4.50; 68 per cent, $4.10; 66 per cent, $4. Prices firm. *Florida,* pebble, domestic, 76@77 per cent, $6; 74@75 per cent, $5; 72 per cent, $4; 70 per cent $3.50. Market fair. *Tennessee,* ground, 97 per cent through 200 mesh, 33 per cent P_2O_5, $9.40 per ton. Brown lump, per gross ton, $5.50 on 75 per cent basis.

Miscellaneous Data

Manganese Ore Imported Into the United States, During Nine Months in 1927

January to September

Month	Cuba (Free) — Gross Weight	Cuba (Free) — Manganese Content	Gross Weight, Short Tons	Manganese Content, Short Tons
January	....	....	38,585	18,098
February	5,591	2,574	51,694	24,175
March	434	190	54,209	25,443
April	289	177	65,688	33,268
May	221	131	39,982	20,410
June	....	....	64,299	41,273
July	....	....	63,922	31,302
August	258	103	53,590	25,720
September	474	243	84,165	40,353
Totals	7,267	3,418	516,134	260,042
Grand totals			523,401	263,460

By Countries and by Months

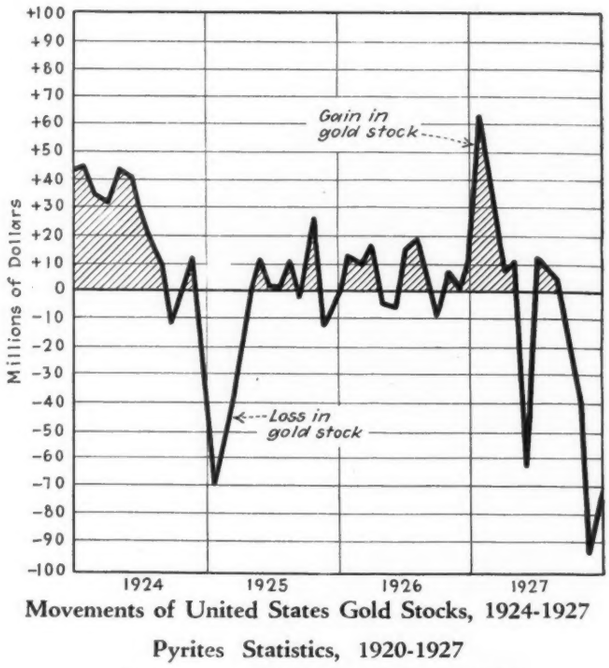
Country of Origin	January — Gross Weight, Short Tons	September — Manganese Content, Short Tons
Germany	62	36
Soviet Russia in Europe	212,291	113,368
United Kingdom	52	28
Canada	321	208
Brazil	135,901	62,804
Chile	3,472	1,762
British India	71,971	37,131
Java and Madura	560	321
Dutch East Indies (Other)	560	325
British West Africa	90,944	44,059
	516,134	260,042
Cuba	7,267	3,418
Grand total	523,401	263,460

Production and Shipment of Crude Sulphur in the United States

(In Gross Tons of 2,240 Pounds)

Year	Production	Domestic Shipments	Export Shipments	Total Shipments	Increase of Stocks
1923	1,255,249	1,040,175	477,450	1,517,625	—262,376
1921	1,879,150	668,672	285,762	954,434	924,716
1922	1,830,942	857,960	485,664	1,343,624	487,318
1923	2,035,847	1,146,316	472,525	1,618,841	417,006
1924	1,220,600	1,055,586	481,814	1,537,400	—316,800
1925	1,409,240	1,228,569	629,401	1,857,970	—448,730
1926	1,898,057	1,495,721	576,966	2,072,687	—182,630
1927 (a)	2,100,000	1,450,000	750,000	2,200,000	—100,000

(a) Estimated



Movements of United States Gold Stocks, 1924-1927

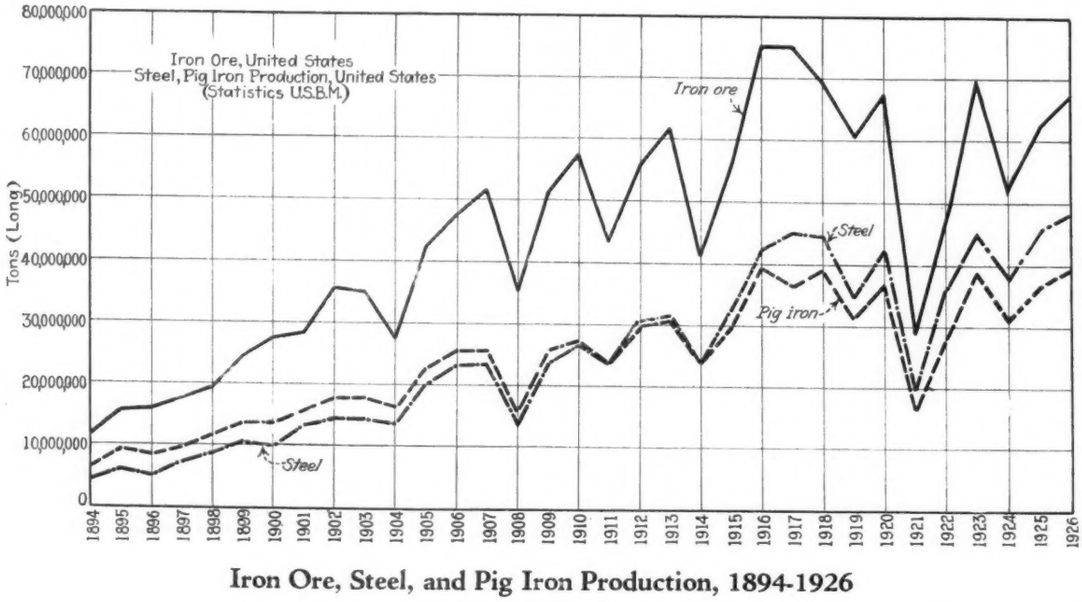
Pyrites Statistics, 1920-1927

Year	Production	Imports	Total
1920	310,777	332,606	643,383
1921	157,118	216,229	373,347
1922	169,043	279,454	448,497
1923	181,628	259,721	441,349
1924	160,096	243,237	403,333
1925	170,081	276,385	446,466
1926	166,550	366,151	532,701
1927 (a)	175,000	300,000	475,000

(a) Estimated.

Imports Into the United States of Platinum, January to August, Inclusive, 1926 and 1927

	1926, First Eight Months, Troy Ounces	1927, First Eight Months, Troy Ounces
Platinum grains, nuggets sponge, or scrap	53,125	58,093
Platinum ingots, bars, sheets, or plates	25,523	31,917
Iridium	1,675	3,380
Osmium and osmiridium	4,325	5,182
Palladium	4,481	2,654
Rhodium and ruthenium	1,132	905



Iron Ore, Steel, and Pig Iron Production, 1894-1926

Mining Practice

By GEORGE J. YOUNG
Associate Editor
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PROGRESS in mining practice in 1927 was directed toward greater concentration of effort, more and better mechanical equipment, greater supervision, and economy. With this has developed a greater effort to reduce accidents and injuries. Probably the most noteworthy development was the successful introduction of an undercut-caving method at Miami, which resulted in low-cost mining at a rate of 12,000 tons copper ore per day. In mining three stopes, involving about 3,450,260 tons, the total shifts of labor were 39,114, or 88 tons per man-shift. The mining cost was 39c. per ton. The result indicates the importance of undercut caving, and reflects credit upon the manager and the engineers responsible.

Prospecting by instrumental or geophysical methods will no doubt continue to occupy the attention of mining men until a technique indicating its specific limitations is developed. Necessarily, the application of instrumental methods will be intimately co-ordinated with geological studies. Literature is developing, and many companies are utilizing various methods. The U. S. Bureau of Mines is investigating the subject, and attention is being also given to it by mining schools. Probably the best résumé of the more prominent methods of electrical prospecting appeared in the April-May bulletin of the Mining and Metallurgical Society of America. Lundberg, Sundberg, Kelly, Zuschlag, and Guilford presented papers. The need for thorough investigation of subtle differences in electrical and magnetic fields is obvious. However, practical results are being obtained, but information about them has been generally withheld by the interested companies, and it is not possible to make a quantitative appraisal of the merits of electrical prospecting at this time. Dr. Richard Ambronn has published a book on geophysics, which no doubt will be followed by others.

Diamond drilling, "long-hole" drilling, and core-drilling in oil wells are more and more called into requisition to prove ground in advance of development and accurately to determine formations. Long-hole drilling is an effective prospecting method in the Tonopah district of Nevada, and has been employed in other mining districts where conditions are suitable. An extensive diamond-drilling campaign resulted in finding ore showings of great importance in the Sudbury district at the Treadwell-Yukon property. Thus the "standard" methods of exploration continue to be vital to the progress of mining, although often supplementary to geophysical and geological methods of exploration.

Viewed broadly, prospecting has developed, under the necessity of coping with more complex conditions than those faced by the "old-time prospector," to the point where trained and experienced men are now functioning, and a technique of no mean order has appeared.

Three papers of general scope dealing with methods appeared in 1927: Charles A. Mitke[1] reviews and classifies mining methods in an interesting way; W. R. Crane[2] describes iron-ore mining practice in the Birmingham district of Alabama, and N. L. Wimmler[3] gives a detailed résumé of placer mining methods and costs in Alaska. Clarence M. Harrer[4] covers various phases of square-setting practice in the Butte district. Thomas C. Baker[5] gives useful information about handling sticky ores underground and describes a cast-iron ore transfer of the pipe type, which was finally adopted and which proved successful as well as economical.

The mining methods at the Silver Dyke mine[6], Neihart, Mont., are unusual examples of undercutting in combination with deep churn-drill holes used to blast the springers of the arch formed by caving and withdrawing the broken ore. The stopes are started as shrinkage stopes, but the clayey nature of the ore prevents the continuance of shrinkage stopes beyond nominal limits. An unusual development of surface pits by blasting deep churn-drill holes in close proximity to a central raise is to be noted at the Silver Dyke.

Bevan Presley[7] describes mining methods in use at Latouche, Alaska, by a method similar in principle to the one employed at the Alaska Juneau property, but differs from this in that drill holes are fanned out from enlargements in the steeply inclined raises put up in the backs of the stopes. Drill holes up to 24 ft. are placed and sprung several times before final charging. Delay blasting caps are used. An average of 0.245 lb. explosive per ton of ore broken is required. Part of the broken ore is retained in the stopes for support, and in this respect the method involves shrinkage stoping. R. R. Van Valkenburgh[8], who discussed the foregoing method, stated that in the application of the Latouche method at Mount Hope, N. J., it is expected that not only will the mining hazard be lessened but that there will be a much greater production per machine-shift as compared with ordinary shrinkage stoping. He points out the similarity of the method to sublevel stoping.

Mining methods at the Morning mine, Mullan, Idaho, are briefly described by C. E. Wethered and S. H. Fairweather[9]. The work involves back-stoping under heavy ground conditions. Mining iron ore at Fierro, New Mexico, by a combination of raises, overhand and underhand stoping, is described by L. M. Kniffin.[10]

A paper by W. A. Quince[11], on narrow-vein mining at the Sub Nigel mine, gives novel details. The use of

[1] *Engineering and Mining Journal*, Vol. 124, p. 405, 565.
[2] Bull. 239, U. S. Bureau of Mines.
[3] Bull. 259, *ibid.*
[4] *Engineering and Mining Journal*, Vol. 124, p. 167.
[5] *Ibid.*, Vol. 123, p. 1037.
[6] *Ibid.*, Vol. 123, p. 236.
[7] Tech. pub. No. 20, A.I.M.E.
[8] *Mining and Metallurgy*, Vol. 8, p. 224.
[9] *Ibid.*, Vol. 8, p. 299.
[10] *Mining Congress Journal*, October, 1927.
[11] Journal, Chemical, Metallurgical & Mining Society of South Africa, July, 1927.

hoe-like scrapers and the protection of the workers by crepe-rubber elbow and seat pads is of interest.

Undercut caving at Miami, a method similar in important features to Inspiration practice, is described by A. J. McDermid[12] in collaboration with the Miami mining staff. The low-grade orebody is blocked out in units, 150 by 300 ft. in areal dimensions, and worked in a single lift. The grizzly level is 100 ft. above the main haulage and the undercutting level 60 ft. above the former. Finger raises serve the undercutting level at 12½-ft. centers. Boundary caving drifts are employed to weaken the sides of the block and restrict the caving between vertical walls of contiguous blocks. Undercutting is started by enlarging end-crosscuts and is continued along longitudinal drifts at the undercutting level, the caving being progressively carried from one end of the block to the other. Felix McDonald and J. L. Johnson[13] give a valuable account of the history of undercut caving.

On the subject of the hardness and toughness of rocks encountered in drilling for blasting purposes, E. G. Gyss and H. G. Davis[14] present the results of classification based on mineralogical composition, hardness by abrasion, and toughness by drop test. The difficulty of getting a useful measure of the "property" of various rocks in respect to drilling and breaking by blasting under mine conditions is apparent and is brought out by the discussion that accompanies the paper. Drilling rate under as near standardized conditions as possible is useful, and a test that can be accomplished. However, the breaking of rocks by explosives involves other factors, one of which is the degree of deformation under impact; but the most important of which is the degree of weakening by incipient fracture planes and slips. It is therefore doubtful if anything more than roughly comparative tables of "drillability" and "breakability" can result.

An article of importance on drill-shop practice is by W. P. Goss[15], who describes the methods in use at the United Verde mine, where hard and tough ores necessitate systematic and carefully controlled drill sharpening. Mention is made of the use of the Gilman tempering machine as well as of pyrometers at the forging furnace. Close inspection of the work of the shop and the results in the mine are essential. Careful selection of drill steel as an important factor is brought out by Goss, who also analyzes cost factors. Another study by C. J. Stein[16] illustrates the systematizing of drill-shop practice for a large group of mines.

Charging drill holes and methods for preparing primers are given by E. D. Gardner[17] in considerable detail. Gardner discusses the use of electric delay blasting caps and the advantages of electric blasting caps. G. B. Holderer[18] describes the use of liquid oxygen explosive in open-pit coal mining. In stripping overburden, one of the less direct advantages of L.O.X. was shown by the fact that repairs of power shovels were greatly reduced because of the easier digging resulting from the greater shattering effect of the explosive.

Probably one of the most detailed researches on the strength characteristics of ore and "top-rock" made in any one district is described by W. R. Crane in Technical Paper 379, U. S. Bureau of Mines. A group of iron-ore mines in the Birmingham district of Alabama was the objective. Compressive and bending tests and measurements of deformation were made. Probably one of the most interesting results was obtained by testing block specimens under vibration. These indicated an increase from 10,708 lb. per square inch to 13,738 lb., ordinary, as compared to tests under vibration. Apparently the compressive strength of an ore is not accurately given by the static test. Crane's work is important, in that more specific rock constants are being obtained, and observations on the action of ore pillars are being recorded.

Surface subsidence due to the removal of petroleum from underground formations is of interest generally, and W. T. Thom, Jr.[19], gives the results of his observations. In the Goose Creek oil field of Texas, a sunken area conforms closely to the limits of the productive field and the total maximum depression at the center of the area amounted to 3¼ ft. The discussion that accompanied Thom's paper brought out other examples of subsidence.

Several short articles, general in scope, have appeared about timber preservation. G. M. Hunt[20] states that the question as to whether preservatives will economically prolong the life of mine timber has been answered in the affirmative. He contrasts the extensive use of timber preservatives in European mines with the relatively scanty use in American mines, but points out differences in conditions. Mention is made of zinc chloride, coal-tar creosote, sodium fluoride, Wolman salts, and similar preservatives. H. E. Tufft[21] gives data about existing timber-preserving plants, costs of treating mine timber, and installation costs for pressure plants. Dr. F. K. H. Moll[22] makes likewise a good argument for the use of preservatives where timber is expected to last five years or more.

Use of steel for support, apart from special underground structures and important adits, has not made much progress in metal mines. However, Alfred Fisher[23] describes an adjustable steel prop of interesting design. In this two H-beam sections are held together by a link, on one side of which is a metal eccentric that sets up greater and greater pressure as one section slides upon the other. Thus the prop offers greater and greater resistance to top pressure, but at the same time it yields along its axis, without distortion. A discussion of the trend of present practice in the use of other materials is given in *Engineering and Mining Journal*, March 12, 1927.

Stoping costs at the Park Utah mine, Park City, Utah, have been reduced 30 per cent by the use of scrapers, according to C. C. Cushwa.[24] At this mine special sheaves have been developed and double-drum Turbinair hoists are in use, as well as one double-drum electric hoist. A steel-cored wire rope was found to be best suited to the conditions. No attempt is made to employ scrapers over distances greater than 125 ft. The scraper weighs 350 lb., but a lighter scraper is used in soft or fine rock.

Lucien Eaton[25] states that on short hauls and in

[12] *Mining Congress Journal*, November, 1927.
[13] *Ibid.*, November, 1927.
[14] *Mining and Metallurgy*, June, 1927.
[15] *Engineering and Mining Journal*, Vol. 123, p. 4.
[16] *Mining Congress Journal*, January, 1927.
[17] Serial No. 2789, U. S. Bureau of Mines.
[18] A.I.M.E., New York meeting, February, 1927.
[19] *Ibid.*
[20] *Ibid.*
[21] *Mining and Metallurgy*, June, 1927.
[22] *Engineering and Mining Journal*, Vol. 123, p. 924.
[23] *Mining and Metallurgy*, August, 1927.
[24] *Engineering and Mining Journal*, Vol. 123, p. 44.
[25] *Mining and Metallurgy*, March, 1927.

switching, storage-battery locomotives have the advantage, but on long hauls the trolley locomotives are without equal. He gives the cost of operating a 4-ton storage-battery locomotive as $12.28 per day (one shift); the cost of hand-tramming as $0.58 per car (1,500 ft.), and for battery locomotive under the same conditions, $0.246 per car. At the Cliffs Shaft mine of the Cleveland-Cliffs Iron Company both 4-ton and 1½-ton storage-battery locomotives are in use. The small storage-battery locomotive offers substantial improvements in underground transportation in both small and large mines.

A general study of mine drainage conditions in the Red Ore mines of the Birmingham district, in Alabama, was made by W. R. Crane[26], who suggests, as a means for lessening the water inflow into the mines, the use of carefully placed diverting ditches; the silting of stream beds and ditches crossing loose surface materials and outcrops of porous formations; the use of flumes and pipes to conduct water over broken ground; checking the caving of stopes and thereby preventing ground movement resulting in surface fracturing; isolating of possible wet areas in the workings; the employment of hydraulic rams to eject part of the water from the mines, and the introduction of caving systems within panels. Preventive steps are less obvious methods of avoiding excessive pumping, and a careful investigation of water sources is a necessary part of the mine drainage problem.

Articles by G. B. Dillingham[27] on the abnormal conditions at Cerro de Pasco relate interesting difficulties in the use of pumping equipment.

Pre-neutralization of cupriferous acid mine water by scrap iron, and pumping by pumps constructed of acid-resisting bronze through wood-lined standard iron pipe, are practices described by C. C. Greenwood[28]. Both centrifugal and multi-plunger pumps were used. All water-ends were of bronze and plungers were of cast steel. Trouble was experienced by incrustation of iron compounds within the pipes, but this difficulty was overcome by clearing the pipe at intervals by the use of scrapers attached to ¾-in. pipe. Scrapers attached to wire ropes were also employed. Types and constructional features of electric motors used for pump operation and the conditions that have to be met are featured in an article by Edgar Gealy[29].

In ventilation, two papers on resistance of airways have appeared—Bull. 261 of the U. S. Bureau of Mines, and Bull. 158 of the Engineering Experiment Station, University of Illinois. M. O. Tillard and E. C. Ranson have discussed the interesting ideas of E. J. Laschinger upon geothermal gradient[30]. Both papers contain important observations upon the control of air conditions in deep mines.

A general description of air conditions and ventilation methods in the Tonopah district of Nevada was given by B. O. Pickard[31].

A frank discussion of the ventilation system at the United Verde mine is given by C. E. Mills[32]. The most significant feature of the improvements carried out at this mine was the elimination of fire hazard on the intake air and the installation for a larger fan to serve present and future requirements. The mine is provided with a primary system of ventilation, and small blowers for secondary service. Steps are being taken to curtail the use of compressed air for ventilation.

One of the novelties in open-pit mining is described by Edgar Gealy[33] and is known as the Woodford system. Haulage equipment consists of separately motored dump cars which receive their current from a third rail. A control tower in which the operator directs the movements of the cars is placed in a central position. A contactor system makes it possible to start, stop, and control the speed and movement. The cars are spotted at the shovels by one of the shovel crew who operates a controller placed upon the shovel. The system is being used in the Palmer mine, in Michigan, and is an excellent example of the extent to which distant control can be developed. J. C. Perkins[34] described the open-pit operations of the United Verde mine. Blasting practice and transportation by motor trucks to transfers are given in detail. Electric shovel operation at the Utah Copper company's open pit was described by C. W. Corfield and R. J. Corfield[35].

Quarry operations, especially where limestone is the objective, are an important phase of mining work, huge tonnages in the aggregate being produced. Where it is necessary to resort to underground operations, low cost methods are essential. Methods for the mining of limestone are treated in extenso by J. R. Thoenen[36]. Frank A. Edson[37] reviews technique of diamond drilling and considers its application to oil-field prospecting and development. Howard R. Drullard[38] and J. Fred Johnson[39] describe methods of shaft sinking and concreting shaft walls.

Significant departures from ordinary practice are the adoption of auxiliary loading buckets or pans in place of the sinking bucket and the use of a cage with extension runners. J. Fred Johnson found that sealing with sand behind timber was effective in stopping rock disintegration in shaft stations. The use of steel blasting bulkheads in shaft sinking in place of securing protection by chaining blasting boards to the shaft timbers is now a common practice. Procedure in sinking a shaft of circular section is described in the *Engineering and Mining Journal* of Oct. 29, 1927, p. 692. G. Townsend Harley[40] brings out the importance of time-study methods in obtaining a better control over mining operations. Lucien Eaton[41] describes the mining practice of the Cliffs Shaft mine of the Cleveland-Cliffs Iron Company, where a large production is made from scattered orebodies. E. Leland[42] touches upon the contracting system as applied at the Pilares mine at Nacozari. Likewise, Everett H. Parker[43] discusses the Elm Orlu contract system. Both papers are of general interest to mine managers. The importance of electric equipment is illustrated by the practice at the Spruce and Leonides[44] mines, on the Mesabi Range. The large electric hoist installed at the Belmont mine, at Butte, Mont., is described in *Mining and Metallurgy* for September, 1927.

[26] A.I.M.E., New York meeting, February, 1927.
[27] *Engineering and Mining Journal*, Vol. 123, p. 796, 847.
[28] *Mining Congress Journal*, October, 1927.
[29] *Engineering and Mining Journal*, Vol. 123, p. 196.
[30] *Journal of the Chemical, Metallurgical and Mining Society of South Africa*, February and April, 1927.
[31] A.I.M.E., New York meeting, February, 1927.
[32] *Mining Congress Journal*, March, 1927.
[33] *Engineering and Mining Journal*, Vol. 123, p. 556.
[34] *Mining Congress Journal*, April, 1927.
[35] *Ibid.*, September, 1927.
[36] Bull. 262, U. S. Bureau of Mines.
[37] Bull. 243, *ibid.*
[38] *Engineering and Mining Journal*, Vol. 123, p. 357.
[39] *Ibid.*, p. 960; Vol. 124, p. 285.
[40] *Ibid.*, p. 722.
[41] *Ibid.*, p. 476.
[42] *Ibid.*, p. 322.
[43] *Mining and Metallurgy*, Vol. 8, p. 16.
[44] *Engineering and Mining Journal*, Vol. 124, p. 51.

Mining Geology

By J. VOLNEY LEWIS
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THE status of mining geology has been strengthened and its scope notably extended by the increasing use of geophysical methods in the search for ores, and especially in the larger programs of exploration for oil. These methods have continued the brilliant record of discovery in the salt-dome region of the Gulf Coast. This is perhaps the most important present-day development. Further stimulation may be expected, particularly in the metal mining field, from active leadership by the U. S. Bureau of Mines in testing methods and in defining their fields of usefulness.

The forthcoming bulletin on the elements of geophysics as now applied will be a welcome addition to the geologist's library, as will those to follow. Meantime, Dr. Max Mason has contributed an excellent outline of the methods used in the search for ores and has presented in a clear and attractive manner some of the results attained in the field and the laboratory.[1]

A distinct advance in the difficult field of leached copper outcrops is marked by the publication of Dr. Locke's book, giving the results of extended research.[2] Similar studies have been made of lead-zinc outcrops by P. F. Boswell and Roland Blanchard, who find, under some conditions, characteristic limonite residues and jasper "boxwork."[3]

Prof. J. H. L. Vogt has discussed and classified magmatic ores as: (*A*) Ore magmas due to (1) liquid phases comparable to matte and silicate slag; (2) concentration of first crystallized minerals, as chromite and some iron ores; (3) concentration in residual magma, as platinum in basic intrusives, gold in quartz veindikes (not all quartz veins); Norwegian pyrite veindikes. (*B*) Deposits by gaseous and hydrothermal agencies, (1) replacements; (2) deposits in openings. The author thinks that Spurr underestimates the significance of the hydrothermal process.[4]

Problems of the batholith touch all other problems of geology and lie particularly close to those of mining and ore genesis. Prof. Frank F. Grout emphasizes the present uncertainty concerning the real nature of these great igneous bodies and urges attack by petrographic and chemical methods of research.[5] Suggestive relations between kinds of ores and the composition and differentiation of igneous rocks in the Coast Range have been pointed out by Prof. A. F. Buddington.[6] Percy A. Wagner has discussed the origin and importance of the pipe form of ore deposits, with particular reference to South Africa—par excellence the land of pipe deposits—including the richest ores of platinum, tin, tungsten, molybdenum, and zinc.[7]

Georg Berg finds the ore deposits of central Europe less distinctly zonal around batholiths than in America and Cornwall. The inner and outer zones are often telescoped, and cryptobatholithic deposits are widespread. Rejuvenation is common, and many rich magmatic ores of the volcanic type, little known in America, are recognized.[8] B. S. Butler has discussed the relations between the oxygen-bearing minerals and the sulphides and their marked separation into temperature zones. The need for chemical investigation is emphasized.[9]

Modern geology had its beginning in the sedimentary rocks, but for a long generation now the study of the sediments has lagged behind the general progress of the science. Unusual importance therefore attaches to the publication of the "Treatise on Sedimentation," by Prof. W. H. Twenhofel and collaborators, which sums up current knowledge and discusses fundamental processes.

Professor Vogt finds noteworthy concentration of platinum metals chiefly due to direct magmatic processes. Only minute quantities occur in ores of other origin. (1) Dunite and pyroxenite with platinum are end products of magmatic differentiation. (2) Platinum in nickeliferous pyrrhotite in norite and related rocks was probably extracted by the mass action of the fluid sulphides.[10] The discovery that the orebodies converge downward toward local supply channels is perhaps the most important result of deep developments at Cripple Creek. Three of these have been worked out by G. F. Loughlin, and their relations to promising ground in neighboring mines outlined.[11]

An outstanding contribution is the new Leadville monograph. The authors find that the leading events of this classic district were (1) porphyry intrusions followed by (2) folding and reverse faulting, and (3) a second period of fissuring and faulting, before important deposition began. The ores were deposited by magmatic waters at moderate temperatures. In the chapter on reserves Mr. Loughlin makes a courageous and praiseworthy attempt to apply the conclusions to the search for additional orebodies.[12] The relative dryness of the parent magma is responsible for the telescoping of high-temperature and intermediate lead-silver deposits in the Hyder district, Alaska, according to W. B. Jewell, who finds that they were formed at considerable depths, some probably at 10,000 ft. or more below the surface.[13]

J. E. Spurr points out similarities between southeastern Missouri and the Kentucky-Illinois ore-magmatic district—basic dikes, early fracturing and ore deposition, later barren heavy faulting—all regarded as manifestations of the greater Mississippi Valley comagmatic region, which also finds expression in basic dikes from

[1] *Engineering and Mining Journal*, Vol. 124, 1927, pp. 766-71, 806-12.
[2] "Leached Outcrops as Guides to Copper Ores," by Augustus Locke, Baltimore, 1926.
[3] *Economic Geology*, Vol. 22, 1927, pp. 419-53.
[4] *Engineering and Mining Journal*, Vol. 123, 1927, pp. 645-50, 682-84.
[5] *Journal of Geology*, Vol. 35, 1927, pp. 311-18.
[6] *Economic Geology*, Vol. 22, 1927, pp. 158-79.
[7] *Ibid.*, Vol. 22, 1927, pp. 740-41. [8] *Ibid.*, Vol. 22, 1927, pp. 113-32.
[9] *Ibid.*, Vol. 22, 1927, p. 233. [10] *Ibid.*, Vol. 22, 1927, pp. 321-55.
[11] *Mining & Metallurgy*, Vol. 8, 1927, p. 357; Technical Publication No. 13, A.I.M.E.
[12] "Geology and Ore Deposits of the Leadville Mining District, Colorado." By S. F. Emmons, J. D. Irving, and G. F. Loughlin. Professional Paper 148, U. S. Geological Survey, Washington, 1927.
[13] *Economic Geology*, Vol. 22, 1927, pp. 494-517.

New York, Pennsylvania, and Tennessee to Arkansas. The underlying magma may be responsible for all metallic ores and many other mineral deposits of the region, as well as the rare but notable earthquakes.[14]

Contrasted with the hydrothermal tin-tourmaline replacement deposits of Caracoles, Bolivia, are the banded tin ores of Chocaya, Bolivia, associated with acid igneous rocks. They were probably derived from an acid magma, deposited at moderate temperature and shallow depth by mobile solutions, in part filling openings along fissures and in a rubble of rock fragments.[15]

Criteria for large-scale tin prospecting in Bolivia are outlined by F. R. Koeberlin, who finds the incentive in the approaching exhaustion of the known tin deposits. The narrow zonal range of the orebodies is an advantage. The relations of trunk fissures to cupolas in the great batholith of the Eastern Range suggest concealed mineralization in a known tin-bearing region 600 kilometers long and 100 kilometers wide. The geologist must select favorable areas to be explored by the geophysicist.[16]

The copper sulphide ores at Ducktown, Tenn., are replacement deposits in limestone that has been complexly folded and faulted. The source of the ore is unknown, but it is probably a deep-seated granite similar to that exposed in a neighboring region. Two epochs of mineralization are recognized: (1) Replacement of limestone by pyrite and silicates; (2) hypogene sulphide replacement of minerals in the ore zone. The ore horizon is believed to underlie most of the area, and hence the reserves are probably large.[17] The famous Rio Tinto ores of Spain, widely regarded as injected igneous ore magmas, are believed by Prof. A. M. Bateman to be replacement deposits formed by magmatic aqueous solutions which followed shear zones. They are compared with many other examples of lenticular pyrite bodies in sheared rocks. All were deeply buried and contain similar minerals, but have no high-temperature minerals, and all have sericitized the inclosing rock.[18]

Specularite veindikes at Iron Mountain, Missouri, have resulted from fissure-filling and crystallization of ore magma in place, according to J. E. Spurr, who confirms the conclusion of Per Geiger. The ore beds of Pilot Knob, on the other hand, are interpreted as beach deposits, like the "black sands" on the shores of Oregon, Colombia, and Japan.[19] The chief iron ores of northern Africa are: (1) Hematite oxidized from siderite; (2) magnetite partly oxidized to hematite. Per Geiger regards them as replacements of magmatic origin in a zoned metallogenetic province around intrusive diorite—the magnetite-hematites nearest, hematites from carbonate ores next, and lead ores most distant.[20]

D. J. Fisher has studied coal analyses by means of triangular diagrams, which bring out clearly the fact that coalification is chiefly dehydration in the earlier stages and devolatilization in the later. In terms of ultimate analyses deoxidation is the most pronounced change.[21]

Prof. Bailey Willis urges analysis of the mechanical development of oil-bearing structures, with the view to a clearer understanding of oil distillation and accumulation.[22] The theory of petroleum distillation during mountain building has been formulated and discussed by John L. Rich.[23]

In the three geosynclines that may be used to test the carbon-ratio theory, W. L. Russell finds that the distribution of marine strata shows that dynamic alteration and not the conditions of sedimentation is chiefly responsible for barrenness of areas having high carbon ratios.[24]

The biogenesis of hydrocarbons by diatoms has been studied by Prof. C. F. Tolman, who summarizes the results of microscopic and field examination of the rocks of the California oil fields and the preliminary studies of diatom epidemics at Copalis Beach, Washington.[25]

Widespread association of bauxite in Alabama with unconformities suggested to Walter P. Jones that weathering and erosional agencies have been concerned with their deposition.[26] George I. Adams finds that bauxite deposits of the Southern states, in both mountains and Coastal Plain, were formed under peculiar physiographic and climatic conditions and that all are approximately the same age—that of the Cumberland baselevel at the close of the Cretaceous. Abundant rainfall and low-lying coasts or lands in advanced topographic development appear to be the essential conditions for deposition.[27]

Bauxitization of clay now in progress in the Gold Coast and in the Guianas has been described. The agency is warm climate ground waters.[28] C. S. Fox has discussed the broad question of the origin of bauxite-laterite deposits and arrived at the "monsoon" theory—the alternation of wet and dry periods. The terra rossa laterites are put in a special class and are thought to be residual mud from aluminous limestone.[29] Laterite and coal are common products of similar climates, and laterites, both fossil and modern, indicate the climatic and geographic conditions of their periods of origin, in the view of Harrassowitz.[30]

Of outstanding interest and value is the "Geology of South Africa," by Alex. L. du Toit, which brings up to date the story of this remarkable region.

Obrutschew's little book on the metallogenetic epochs and regions of Siberia also deserves special mention. The author gives an outline of the geological history of the region and sketches the relations of ore deposits to the major events. Close connection is shown between orogeny, igneous intrusion, and ore deposition.[31] Among state summaries, "The Geology of Alabama" has been welcomed as one of the best.[32]

Continued advance in the science of geology and the closely related art of finding the mineral treasures demanded in ever-increasing amounts, whether gold, iron, oil, or clay, depends on keeping the open mind. Dr. Augustus Locke cogently reminds us that hypotheses assist inquiry, but adopted as axioms or established laws they bring it to an end.[33] To him who would "read the secret of the rocks and open the portal for the outpouring of their riches" the inquiring mind is essential.

[14] *Engineering and Mining Journal*, Vol. 122, 1926, pp. 968-75. [15] M. J. Buerger and J. L. Maury, *Economic Geology*, Vol. 22, 1927, pp. 1-13. [16] *Engineering and Mining Journal*, Vol. 123, 1927, pp. 278-85. [17] "Geology and Ore Deposits of the Ducktown Mining District, Tennessee." By W. H. Emmons and F. B. Laney, with collaboration of Arthur Keith. Professional Paper 139, U. S. Geological Survey, Washington, 1927. [18] *Economic Geology*, Vol. 22, 1927, pp. 569-614. [19] *Engineering and Mining Journal*, Vol. 123, 1927, pp. 363-66. [20] *Economic Geology*, Vol. 22, 1927, pp. 537-64. [21] *Journal of Geology*, Vol. 35, 1927, pp. 639-46. [22] *Bull.* American Association of Petroleum Geologists, Vol. 11, 1927, pp. 31-47. [23] *Ibid.*, Vol. 11, 1927, pp. 1139-49. [24] *Ibid.*, Vol. 11, 1927, pp. 977-89. [25] *Economic Geology*, Vol. 22, 1927, pp. 454-74; 356-68. [26] *Ibid.*, Vol. 21, 1926, pp. 792-802. [27] *Ibid.*, Vol. 22, 1927, pp. 615-20. [28] *Bull.* No. 1, Gold Coast Geological Survey, 1927. [29] "Bauxite." By C. S. Fox. London, 1927. [30] "Laterit, Material under Versuch erdgeschichtlicher Auswertung." By Hermann Harrassowitz. Berlin, 1926. [31] "Metallogenetischen Epochen und Gebiete von Siberian." By W. A. Obrutschew. Halle, 1926. [32] "Geology of Alabama." By Geo. I. Adams, Charles Butts, W. L. Stephenson, and Wythe Cook. Special Report No. 4, Geological Survey of Alabama, 1926. [33] *Economic Geology*, Vol. 22, 1927, pp. 80-84.

Ore Dressing

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THE leading developments in ore dressing continue, as in the last few years, along the line of flotation, which at one and the same time is increasing its selective action and also broadening its scope. Advances in flotation overshadow progress in crushing, tabling, and other forms of concentration and in general milling practice.

In crushing, the Newhouse breaker with electric-motor drive directly above the vertical spindle is understood to continue to give satisfaction at Miami. Likewise, the Symons cone crushers are doing excellent work in general where the feed is not too coarse. No further report has been received on the Williamson ball mill at Inspiration, which has step-like or wing-shaped extensions in place of end liners to give more mixing and increased efficiency. An important discovery in the case of the Hardinge conical ball mill is that mills 10 ft. in diameter show an over-all efficiency about 20 per cent greater than 7½-ft. mills. This is probably due to the greater mass action of the larger mill. The latest development in rod mills is the Hardinge, with both ends in the form of flattened cones, an arrangement whereby the discharge may be made at any desired point from the center of the discharge end to the periphery.

Work continues by the U. S. Bureau of Mines at Salt Lake City, and by others elsewhere, on crushing theory, including the demonstration of the Rittinger theory and the actual measurement of the work involved in crushing.

Vibrating screens hold the field for sizing. The latest one to appear on the market is the James, which has a special gyrating head that imparts rapid impulses to the screen. The screen itself is suspended by members that are slightly inclined from the vertical, so that the motion of the screen is a combined horizontal and vertical one. Further improvements have been made on the Traylor Screen Supreme. A gasoline-engine drive has been perfected for the Leahy vibrating screen, to be used in installations where belt or electric-motor drive is not available.

WIDER USE REPORTED OF HYDRAULIC DESLIMERS

Although the old-time use of classifiers for grading the feed to jigs and tables is on the wane, the importance of better classification in closed-circuit grinding and in desliming operation is becoming apparent. The Fahrenwald constant-density classifier, now marketed by the Dorr Company as the Fahrenwald sizer, comes the nearest to giving perfectly classified products of any yet invented, and therefore is taking the lead over other types. Hydraulic deslimers are being found to be more efficient than the various forms of settling cones and mechanical classifiers.

Dorr thickeners hold the lead for slime settling and water classifying in general, and the tendency is toward the peripheral-traction drive in place of the central drive. A special form of traction drive has been developed for square or rectangular tanks. Another new wrinkle is the Dorr balanced tray thickener, in which the best rate of flow from each tray is automatically maintained, and dilution of the underflow prevented. The largest Dorr thickener yet constructed is that at Miami, 325 ft. diameter, to handle 16,000 tons of tailing and recover 11,500,000 gal. water daily.

It is to be noted that the growth of the Hardinge super-thickener has been from one machine in 1924 to more than 60 in 1927. The value of the Genter filter thickener is evidenced by the manufacture by other firms of apparatus operating on the same principle. The Hydrotator thickener has so far been pushed more in the coal field than in the metal field.

VACUUM FILTRATION PRACTICE EXPANDS

For straight filtering by suction, the appearance of the Dorrco filter in 1927 marks a distinct and logical step in advance. This sucks outward through a filter cloth, which is on the inside of a horizontal revolving drum, a pool of pulp being retained in the lower part of the drum by a flange extending inward from the periphery of the open end of the drum. Coarser particles settle first on the filter cloth, and finer particles on top of the coarse, thus forming an ideal cake, which is thicker and more pervious than is the case where the filter cloth is on the outside of the drum and the suction is inward from a tank of pulp in which the revolving drum dips. A continuous centrifugal filter has been recently placed on the market by the Laughlin Filter Corporation.

Nothing new is to be reported on jigs. A new form of riffle, the "pinch riffle," has come into use in the Southeast Missouri lead district. The riffle cleats widen toward the concentrate-discharge end of the table, thus narrowing or pinching the space between the riffles and improving the separation of the concentrates from the gangue. Displacement of tables by flotation is being offset to some extent by the use of pilot tables in flotation plants and in the application of tables for further cleaning flotation concentrates, especially in the differential flotation of lead-zinc ores.

A further study of the theory of stratification, with special reference to tables treating coal, has been made by B. M. Bird.[1]

No special progress has been reported in magnetic, electrostatic, dielectric, and centrifugal separators. Dry or pneumatic concentration continues to expand in table work on coal.

A new pyroelectric process in which the ore is heated to about 200 deg. C., and flows over a set of inclined glass plates, placed zigzag, is used for separating mica from sand in California. The mica adheres to the glass.

[1] *Mining and Metallurgy*, Vol. 8, p. 145.

Another new method of mechanical separation, depending on color and luster, has been developed in the laboratory of the Michigan College of Mines. It involves the use of a light-sensitive potassium cell, which is affected by the light reflected from the ore particles and thus controls the current delivered to electro magnets, which operate a mechanical device for removing any desired class of mineral grains from a picking belt by suction. So far this device seems to be of academic interest only.

Flotation has progressed along the lines of differential flotation, improved reagents and more efficient machines. This process, and especially differential flotation, has been the salvation of many mines, and has caused old mines to be reopened and new mines to be started. A notable example of the last class is the Buchan River mine, in Newfoundland. This deposit has been known for many years, but the finely disseminated ore could not be concentrated. Every time a new development in flotation was made, it was tested out on this ore, but without success until recently, when it was found that the latest form of differential flotation would apply. The concentration problem being solved, the American Smelting & Refining Company, which owns the property, proceeded with prospecting, and has already an indicated tonnage of 3,000,000 tons, assaying about 16 per cent zinc, 7 per cent lead, 2 per cent copper, high iron as pyrite, 0.03 oz. gold and 2 oz. silver per ton. A 600-ton mill is under construction, which will float the lead, zinc, and copper differentially, and discard the pyrite and gangue in the tailing.

Opportunities for Technical Improvement Appear to Be Less

In some instances, costs and efficiencies have reached the point where little more remains to gain. The Utah Copper Company reports, on an ore containing 0.99 per cent copper, an extraction of better than 90 per cent, by the use of di-cresol-di-thio-phosphoric acid, called phospho-cresylic, or by trade name, "Aero Float." The total cost of copper production by this company in 1926 was 7.94c. per pound. Lower-grade material can now be handled at a profit, and reserves have been recalculated and consequently much increased. The last official report gave 564,000,000 tons, averaging 1.1 per cent copper, including everything assaying over 0.70 per cent. Material as low in grade as 0.5 per cent copper cannot be handled without loss. The daily tonnage being treated is 36,000 tons, which, using the above reserves, gives an estimated life of 43 years. The cost of mining, transportation, and milling has been estimated to average 90c. per ton.

The new United Verde 1,200-ton mill has gone into operation, to separate copper from iron and gangue; and the Anaconda mill has been remodeled to eliminate most of the jigs and tables, and grind the ore direct to fine size for flotation, which will recover the copper and send most of the pyrite into the tailing.

On Canadian gold ores, flotation is becoming a valuable adjunct to cyanide, as it serves to take out tellurides for special treatment or to remove copper or other difficult and objectionable minerals. Likewise, flotation has been introduced in the flow sheet of the Portland gold mill, at Cripple Creek, to recover the fine telluride, which was formerly inefficiently treated by cyaniding. The problem of concentrating the platiniferous sulphide ores of South Africa seems in a fair way to be solved by flotation.

Differential flotation of lead, zinc, copper, and iron continues to gain in technique and in tonnage under the stimulation of custom milling plants and electrolytic treatment of zinc concentrates, and is having a marked effect on the economic position of lead and zinc. The increased lead production in the Rocky Mountain district has lowered the price of lead and also that of zinc. If the production of the latter continues to increase, a situation may develop where production will exceed the demand, and high-cost or low-grade zinc mines may have to close. Already the conditions in the Tri-State district are none too hopeful.

Zinc Production and Technology Closely Connected

Utah produced 24,000 tons of zinc concentrates in 1924, 60,000 tons in 1925, 144,000 tons in 1926, and 150,000 tons (estimated) for 1927, the gross value being about $40 per ton. The saving to the miners by lowered smelting charges on lead ores, and no penalty for the zinc in these ores, amounted to $3,500,000 in 1927. Ore production of Park City, Utah, increased from 145,000 tons in 1925 to 230,000 tons in 1927. The Midvale smelter formerly received monthly about 4,000 tons of jig and table lead concentrates and about 1,000 tons of iron concentrates with 5 per cent lead and 10 to 11 per cent zinc. Now it handles 4,300 tons of flotation lead concentrates assaying 60 per cent lead and 4.5 per cent zinc, and 4,000 tons of flotation pyrite concentrates containing 3.5 per cent zinc.

At the International lead smelter, at Tooele, the zinc lost in the slags has been cut from its former figure of 50,000 tons per year to 25,000 tons, thus saving $800,000 to $900,000 annually in zinc. It costs 30c. to 40c. to slag off a unit (20 lb.) of zinc in a lead blast furnace. The point has even been reached where the Anaconda company is recovering zinc from old lead blast-furnace slags.

In the Tri-State district the effect of differential flotation has been to make it profitable to mill many of the old tailing piles.

A somewhat unusual separation is that of lead and copper in one section of the Utah Apex mill. The first step is to float the lead and copper together and depress the iron with the tailing, xanthate being used as the reagent. The second step is to deaden the copper by the use of 1 lb. lime and 0.5 lb. sodium sulphide per ton and float the lead. The lead concentrate assays 43.3 per cent lead and 5.60 per cent copper; the copper concentrate assays 1.83 per cent lead and 21.15 per cent copper; and the tailing assays 0.778 per cent lead and 0.42 per cent copper.

Flotation Research Continues

In the field of oxide and non-metallic minerals, commercial practice is limited to the flotation of the lead and copper minerals after sulphide filming. The U. S. Bureau of Mines has floated limestone and phosphate experimentally, and has hope of floating bauxite. T. F. Mitchell[2] has reported that non-metallic and gangue minerals will float under right conditions. The time may come, therefore, when differential flotation will not

[2] *Bull.* University of Utah, No. 17, p. 25, Jan., 1927.

be confined to sulphides. An unconfirmed report has been received that manganese in the form of pyrolusite is floated, and A. C. Vivian[3] has published some promising laboratory results on the flotation of cassiterite by the use of cupferron and coal-tar frothers. The cupferron forms an unwettable film on the tin oxide.

The MacIntosh and Forrester flotation machines represent the latest advance in pneumatic flotation. The former, handled by the General Engineering Company, replaces the fixed blanket of the Callow cell with a horizontal revolving cylindrical blanket. This cylinder may be easily installed in existing Callow cells and this change is being made to a considerable extent. The advantage of the MacIntosh cell is that clogging of the blankets is reduced and their life prolonged. The Forrester cell does away with blankets entirely. Several installations of this cell have been made, that of the entire Nevada Consolidated mill being the largest so far. In its first form this cell consumed considerable air, but it is understood that construction has now been modified to reduce the air consumption. For supplying the air to pneumatic cells at a pressure of 2 or 3 lb. per square inch, centrifugal compressors are coming into use.

Utah Copper Develops New Agent

The latest flotation agent is Aero Float, or phosphorcresol, made by reconstructing high-grade cresylic acid with phosphorus penta-sulphide. It was developed by F. T. Whitworth in the mills of the Utah Copper Company. It promotes the flotation of copper sulphides, galena and blende, but does not lift pyrite. Thus it is finding a field in copper, lead, and zinc mills where iron is present. A new reagent is also being used with much success at the Braden mill, in Chile, but details are withheld. Xanthate and other reagents for frothing, collecting, and conditioning continue in use on about the same scale as during the preceding year or two, but the intensive research being made by several firms in this field will undoubtedly result in new and improved reagents.

The detrimental effect and control of soluble salts, especially sulphates, in the ore or in the water, are becoming better understood. Lime generally remedies trouble from this source by precipitating these salts from solution. Different classes of slime may require different flotation treatment. Thus, soluble salts may be higher in the original slime made in mining than in the slime formed in the mill by crushing, and in this case the original slime would be separated out for separate treatment as the first step in the mill process. In other cases, slime washing may be used to remove undesirable soluble constituents before flotation.

Litigation Result Still an Uncertain Factor

The incubus of litigation still hangs over flotation. Another year has passed without a decision in the Magma case, making five years in all. The suit of the Metals Recovery Company against Anaconda, involving the Perkins and Keller patents and the use of xanthate, was scheduled for trial at Butte in June, but was postponed. No date has been set for the case of the Great Western Chemical Company against the Nevada Consolidated Copper Company for damages arising from manufacture of xanthate by the defendant and consequent infringement of the Rosenstein patent owned by the plaintiff.

The fundamental question of why minerals float remains still unanswered, but much has been learned about the control of their flotation property. The chemist has demonstrated that the rôle of addition agents is to form surface coatings or adsorbed films on mineral particles, thus causing a modification of the character of the surface and affecting and controlling the affinity of the modified mineral particle for the frothing agent.

Of significance is the fact that the almost instant recognition of the value of the pamphlet by Weinig and Palmer[4], as representing the best summary of flotation knowledge obtainable in print, led to a rapid exhaustion of the first edition. A second edition has been printed. The regional meeting of the A.I.M.E. at Salt Lake City in September, in conjunction with the American Mining Congress, was featured by papers and discussions on flotation. The papers contained many new and valuable data, and have appeared in print as A.I.M.E. Technical Papers as follows: No. 1, by A. W. Fahrenwald, "Flotation Practice in the Coeur d'Alene District"; No. 3, by A. T. Tye, "Effect of Preferential Flotation at Cananea"; No. 4, by A. M. Gaudin, "Flotation Mechanism —A Discussion of the Functions of Flotation Reagents"; No. 5, by G. H. Ruggles and H. F. Adams, "Recent Flotation Practice at Inspiration, Arizona"; No. 6, by E. H. Mohr, "Forrester Cell Installation at the Nevada Consolidated Copper Company's McGill Concentrator"; No. 7, by W. L. Zeigler, "Concentration of Lead-Zinc-Silver Ore at the Hecla Mine, Gem, Idaho"; No. 8, by W. L. Zeigler, "Galena Flotation Concentrator, Lake Gulch, Idaho"; No. 9, by R. W. Diamond, "Ore Concentration Practice at the Consolidated Mining & Smelting Company of Canada, Ltd."; No. 10, by A. W. Hahn, "Flotation of Oxidized Lead-Silver Ores." Two other notable papers dealt with selective flotation[5] and with flotation reagents and practice.[6]

Belt Conveyors with Renewable Surfaces

An improved conveying belt is being made by the Boston Woven Hose & Rubber Company, with a rubber wearing sheet or belt running on, but separate from, the transmission belt in place of the older form in which the rubber was so applied as to be an integral part of the transmission belt.

Dust-control equipment is now almost universal in mills of the Southwest. The mill of today is simple, systematic, and clean, which has brought about improved morale and increased the efficiency of the millmen and the mill itself.

Important new mills, completed or under construction, are the United Verde in Arizona, the Pecos in New Mexico, the Noranda in Quebec, and the Buchans River in Newfoundland. The valuable and comprehensive and long anticipated 1,700-page "Handbook of Ore Dressing," of which A. F. Taggart is the author, finally appeared in 1927.

Coal preparation made considerable advance during the year. The most important feature was the rapid expansion of the Rheolaveur in the United States from nothing in 1925 to 2,750,000 tons annual capacity in September, 1927. Dry tables have likewise found more application, and also Dorr thickeners and hydroseparators for handling slush and recovering water.

[3]*Mining Magazine*, Vol. 36, p. 349.

[4]*Colorado School of Mines Quarterly*, Vol. 21, No. 2.
[5]C. S. Parsons. *Engineering and Mining Journal*, Vol. 123, p. 757.
[6]H. S. Geser. *Ibid.*, Vol. 123, p. 842.

Hydrometallurgy

Editorial Summary

IN THE FIELD of copper leaching, one of the features of 1927 was the success, metallurgic and economic, of the new Inspiration leaching plant, the first large-scale operation for the direct leaching of copper sulphide, almost all of which at Inspiration is chalcocite, and readily and completely soluble in solutions of ferric iron of sufficient strength. Warming of solutions helps the reaction, a step that has proved practicable and cheap.

A description of the new Inspiration plant and its operation during the first six months of 1927 is given in a paper by H. W. Aldrich presented at the Globe-Miami meeting of the Arizona Chapter of the American Mining Congress. Small variations between actual costs and estimates of probable costs are to be noted, but the six months' average is close to that predicted.

During 1927, extensive tests on heap leaching were carried out by the Pinto Valley company, in Arizona. It is understood also that one or two other companies are continuing tests that may lead to installations of this leaching method. In the October and November, 1927, issues of the *Mining Magazine* will be found interesting and complete articles on heap leaching and precipitation practice in Spain, by J. H. Fennell.

C. H. Benedict, the "father" of the ammoniacal leaching of copper ores, reports considerable headway in 1927, particularly in regard to economic and metallurgic efficiency, due to improvement in many details of operation. Much interest is being evinced in the process, not only for the treatment of copper ores but also for the extraction of zinc from its ores. Calumet & Hecla is recovering from 87 to 88 per cent of the contained copper by the ammonia leaching of sands with an original copper content of from 10 to 14 lb. per ton, as compared to 80 to 82 per cent previously, due to a change in the cycle. Reductions in cost have resulted mainly from economies in steam production, partly by the use of a reducing-pressure turbine for process steam and partly by a decided increase in the efficiency of still operation. The Lake Superior district as a whole has made no decided advance during 1927, but is struggling bravely to reduce costs in line with the low price of copper.

Details of the process introduced by the Mount Elliott company at Cloncurry, Queensland, are supplied by Henry S. Mackay, who was responsible for the development: A mixture of oxide and sulphide ores is proportioned in amount required to insure the production of sufficient acid. The crushed ore, to pass $\frac{1}{4}$ in.-mesh screen, is roasted in a Mackay furnace, of modified Wedge design, with seven roasting hearths and one drying hearth, the roast being so controlled that the copper in the ore is converted from a sulphide to an oxide and a sulphate, and the iron to an insoluble oxide. Water is used for primary leaching, which dissolves the copper in the form of sulphate. When the concentration of copper in the effluent has reached 3 per cent, the solutions are purified to remove contaminants and then are pumped to the cell room for precipitation by electrolysis.

The leaching of manganese ores was discussed at a joint meeting of the Ohio section and the Iron and Steel Committee of the A.I.M.E. in Cleveland, in April, 1927, at which L. B. Miller read a paper on the Bradley process for treating siliceous manganese ores, involving the reduction of MnO_2 to MnO, leaching the 80-mesh material, with the production of a solution of $MnSO_4$, precipitating with ammonia as $Mn(OH)_2$, the latter being calcined to produce MnO_2.

Nothing of interest was reported in the hydrometallurgy of vanadium during 1927. A little larger tonnage was treated hydrometallurgically than in former years, owing to a larger production of ore at Rifle, Colo. Only a part of the Peruvian ores is treated thus, the major bulk being smelted direct in the electric furnace, owing to the higher vanadium content and lack of impurities. Some of the South African ores, which are complex, containing, besides vanadium, lead, zinc, copper, and arsenic, have not been successfully treated hydrometallurgically, and for this reason no appreciable importation of such ores into this country has occurred. An electrolytic cadmium plant, capable of treating 15 tons of zinc-dust purification residue per day, containing about 1 ton of cadmium, was put in operation in 1927 at the Consolidated Mining & Smelting Company's plant at Trail, B. C.

A bulletin on the treatment of zinc ores by ammonia, by H. M. Lawrence, metallurgist at the Mississippi Valley Station of the U. S. Bureau of Mines, has been issued by the University of Missouri. In summary and in amplification of this, Mr. Lawrence views the possible applications by this method as follows: (1) for the treatment of zinc-bearing material produced by table concentration or flotation, collective or selective, from complex ores; (2) for the treatment of amenable baghouse or fumed products; (3) for the treatment of complex ores by leaching the fume produced by the smelting of complex ores in a fuming furnace; (4) as an adjunct to present electrolytic practice; and (5) for the production of a pure zinc oxide.

The process of W. G. Waring is comprehensive and possible of general application. Several features have been investigated, and it is understood that a company is being organized to operate the process in the Tri-State district. Mr. Waring has proposed that complex ores or concentrates be smelted in a fuming furnace (U. S. Patent No. 1,652,224, Dec. 13, 1927) to obtain a separation between the easily volatilized elements that pass out of the furnace to be recovered as a fume and the remaining substances that enter the matte or slag, as the case may be.

Treatment of lead-zinc fume products by ammonium carbonate solutions effects a dissolution of certain zinc compounds, although some fumes are more amenable than others and a larger extraction of the zinc results. Engineers for a prominent Western smelting company

have prepared estimates for a Waring plant to treat 25 tons of fume per day containing 60 per cent zinc and 10 per cent lead, based on tests carried out by them in Mr. Waring's experimental plant. The estimates did not include engine or boiler, but for the remainder of the necessary apparatus the figures show about $3,000 per ton of daily capacity. Operation is estimated to cost about $8.75 per ton of fume treated, including $2.50 for labor, $3.75 for reagents, and 75c. for fuel. The estimates for labor are reasonable, reagent cost should be no higher and ought to be less, but fuel cost may be a little low. This cost of $8.75 per ton of fume amounts to 0.7 to 0.8c. per pound of zinc in the form of basic zinc carbonate; refining of the latter would be an additional cost.

The ammonia process produces a pure zinc oxide, and consideration might be given to its application as an adjunct to present electrolytic zinc practice. Sintering and fuming zinc ores now treated by the electrolytic process, and leaching the fume products by the ammonia process, would furnish a zinc oxide containing little impurity. The material could then be charged directly to spent electrolyte with the assurance that a pure zinc sulphate liquor would be secured. Thus the electrolytic process would be relieved from purification steps now required to produce pure zinc sulphate liquors from roasted ores. As electrolytic practice is fairly well standardized, possible application of the ammonia process may seem far fetched, but speculation on its possibilities is interesting. In Colorado, T. P. Campbell has investigated the problem of the electrolytic precipitation of zinc from liquors obtained by leaching zinc ores with ammonium carbonate solutions. In the Dec. 10 issue of *Engineering and Mining Journal* appeared an interesting summary and review of electrolytic zinc practice, by A. A. Zentner. The Coolbaugh process operated at Durango, Colo., throughout 1927.

In the production of electrolytic zinc no important developments occurred during 1927. Each of the large plants at Great Falls, Trail, and Risdon increased output. The combined total of these plants now amounts to about 700 tons daily. The Anaconda company started erection of a new electrolytic zinc plant of a daily capacity of 150 tons at Anaconda.

At Kellogg, Idaho, an electrolytic plant using the Tainton-Pring process is being erected by the Sullivan Mining Company, which is owned jointly by the Bunker Hill & Sullivan Mining & Concentrating Company and the Hecla Mining Company. Originally announced for 50 tons of metal a day, the plant is being designed for an ultimate output of 150 tons, and much of the equipment now installed is already of this capacity.

Metallurgically speaking, electrolytic zinc practice showed comparatively little change. The Anaconda company and the Consolidated Mining & Smelting Company continued their investigation of methods of smelting residues in such a way as to recover some of the unextracted zinc. At Trail, this work is proceeding along electro-thermic methods, whereas the Anaconda company has returned to fuel-fired volatilizing furnaces. A plant of this type is under construction at East Helena to recover the zinc from lead blast-furnace slag.

Precipitation of cobalt from zinc solutions received attention as more trouble was experienced from accumulation of this metal. Trail has investigated methods of stripping solution of zinc and then discarding, and also of precipitation with permanganate. Risdon has gone over from the use of its zinc-arsenic couple to nitrosobetanapthol. The problem is unsolved.

The Anaconda company adopted Moore filters for residue filtration, thus indorsing Risdon practice, and extended the so-called third leach—a strong acid treatment of the residues from the acid thickener circuit. The strong acid reduces residual losses and also brings into solution more iron, which when precipitated later, purifies the solutions of arsenic and antimony.

A legal decision of importance to the electrolytic zinc industry was given in 1927 in the case of the French Ore Reduction Company versus the Electrolytic Zinc Process Company in Canada. The French company had alleged infringement of its patent relating to the oxidation by manganese in zinc electrolysis. The court in giving judgment for the Electrolytic Zinc company declared that the use of manganese dioxide in zinc electrolysis was old in the art, and that oxidation was a natural phenomenon requiring no ingenuity to bring it about, but rather calling for inventive genius to prevent it. This decision clears the air of uncertainty in regard to other patents dealing with the same subject.

The Bunker Hill & Sullivan company continued operation of the electrolytic lead plant at Kellogg, and increased the capacity to the treatment of 400 tons of tailing per day. This plant makes use of the Tainton electrolytic cell, in which the metal is deposited in a nonadherent form on a moving cathode, detached by the friction of solution or by scraping, then pressed and melted.

The Cerro de Pasco Copper Corporation started operation of a pilot plant designed on similar lines by U. C. Tainton and his associates. This plant is treating about 50 tons per day of the so-called *pacos,* an oxidized silver-lead ore of which a large deposit exists. Preliminary reports from the plant indicate that low treatment costs can be attained, and there appear to be no metallurgical difficulties in the way of a high recovery, so that large-scale treatment of the deposit may be expected as soon as sufficient data have been accumulated.

Most of the 1927 cyanide plants were built in Ontario or on the Witwatersrand. In the latter district, Modder East constructed a new plant with a capacity of 60,000 tons per month. The crushing equipment follows the practice of West Springs and New State Areas in substituting large tube mills for stamps. The mills have a diameter of about 7 ft. and are fed with from 30 to 50 tons per day of sorted mine rock, up to 8 in. in diameter. This practice results in an accumulation of partly crushed ore in the mill, removed through a 1½-in. grid at the discharge end, followed by a ⅜-in. trommel, the undersize going to the classifiers in the usual way and the oversize going through a special set of rolls or Symons-Hadfield crushers before being returned to the same circuit. It is maintained that there is little if any difference in the operating cost of the two systems, but that a substantial saving in capital cost is effected by the choice of tube mills in place of stamps. The existing plants at Sub Nigel and at the West Rand Consolidated have been remodeled and enlarged, with the adoption of continuous vacuum filters.

A new mill of about 30,000 tons' capacity per month is being built for the Ariston Gold Mines, Ltd., formerly the old Prestea mine, Gold Coast Colony. This mill will

retain the existing stamps, which will be followed by tube mills with Dorr bowl classifiers. Amalgamation in water will be practiced. The tailing will be thickened and then treated with a special reagent to prevent premature precipitation of the gold. Cyanide is then added to the thickened pulp, followed by treatment in Dorr agitators and filtration on continuous vacuum filters. As with the Modder East, Sub Nigel, and West Rand Consolidated plants, precipitation will be effected by the Merrill-Crowe process, using the vacuum-leaf system for precipitate collection.

In Canada, new mills were built in 1927 at the Teck-Hughes, Sylvanite, Associated Goldfields, and Gold Hill mines, in the Kirkland Lake district, and at the Central Manitoba Mines, in Manitoba. The flow sheets of these plants indicate crushing in solution in ball mills, followed by grinding in tube mills, using steel balls as grinding media, and Dorr bowl classifiers. In one or two instances a standard Dorr classifier has been used in closed circuit with the ball mill, thereby increasing time of contact in the crushing circuit. The classifier overflow, varying from 90 per cent to 98 per cent minus-200 mesh, goes to the Dorr thickeners, followed by agitators of the same make, and filtration on continuous vacuum filters. Precipitation in all cases is effected by the Merrill-Crowe process, using pressure filters.

Two distinct tendencies are in evidence. One is to effect a greater degree of classification in the grinding circuit, with the idea of returning the fine sulphides and thereby grinding them finer than the gangue and at the same time holding them longer in the grinding circuit. This results in an accumulation of sulphide particles in the grinding circuit and in a considerable increase in the gold dissolved there. J. J. Denny, of the McIntyre-Porcupine mine, has been the chief exponent of this improvement, which has since been adopted at several of the plants in Kirkland Lake with great advantage. Kirkland Lake has unusually high-grade ore, parts of which are refractory. Obviously, the more gold that can be dissolved ahead of the primary thickeners, the simpler will be the agitation and filtration problem at the other end of the plant.

Another innovation now used in several of the mills in the Northern country is tandem filtration on continuous vacuum filters. This step, sponsored by B. D. Kelly, of Timmins, and described in *Engineering and Mining Journal* in 1924, has proven to be sound metallurgy in many cases. It is particularly adaptable in the Northern country, because many of the ores there are of higher than average grade. Moreover, it allows the use of a compact milling plant; large thickeners can be avoided. This results in a considerable saving of heat in the winter months. The Benguet Consolidated, P. I., has adopted triple filtration on Olivers in its new 100-ton Balatok mill, cyaniding a high-grade gold ore. Double filtration on Olivers is also in use in the Flowery mill, near Virginia City, Nev., and at the Sta. Gertrudis mill, in Pachuca, where Butters and Merrill filters are used.

An interesting development is reported from the Paymaster mine, at Porcupine, which contains large tonnages of porphyry, mineralized with gold-bearing pyrite. A concentrator of 2,000 tons' daily capacity is being built, and it is proposed to crush the ore by rolls and ball mills to approximately 30 mesh, followed by table concentration, making a concentrate that will be further reground and cyanided in the existing 300-ton plant. It is expected that a satisfactory net recovery per ton will be made. A low mining cost, possible by the nature of the ore-body, and a corresponding cheap milling process, is expected by the sponsors to effect profitable operation.

At the Flin Flon mine, in Manitoba, a 30-ton test mill was in operation during the summer of 1927, treating a medium-grade zinc, lead, copper, gold, and silver ore by selective flotation, followed by cyanidation of the flotation tailing. The ore contains an unusually high percentage of sulphide, and even the flotation tailing going to the cyanide plant will contain upward of 30 per cent sulphur, together with a small amount of copper and zinc and about $1.30 in gold and silver. A fair recovery of the gold and silver can be made, and the otherwise prohibitive cyanide consumption is kept to a reasonable figure by the use of a cyanide regeneration process. As the proposed mill, if erected, will embody both roasting and electrolytic-zinc equipment, either sulphur dioxide or sulphuric acid will be available for use in the recovery process at a low figure.

The Merrill cyanide recovery process gives good results at the Fresnillo and Santa Gertrudis units of the Mexican Corporation, at the Guerrero mill of the Real del Monte company, and at Cinco Minas. A similar plant is now under construction for the San Luis Mining Company in Durango, and plants are also in operation at the New York & Honduras Rosario Mining Company and the South American Development Company. This process is not likely to prove of value in the treatment of ordinary gold ores, but it does effect a saving in the cyanidation of most silver ores. A field of application may exist in the treatment of base ores where, because of the presence of copper, the consumption of cyanide would otherwise make the use of the cyanide process impracticable. The principal item of cost in the operation of the recovery process is the acid radical to neutralize the solution. Where this can be obtained by roasting sulphide ores, as is now done at Fresnillo by roasting an iron flotation concentrate, the operating cost is low.

Several small cyanide plants were built or are under construction in Mexico, but little new metallurgy is to be recorded unless it be the new roasting-cyanidation plant at the Achotla unit of the American Metal Company. The ore is to be given a chloridizing roast with salt in shaft furnaces, followed by vat leaching with cyanide solution and precipitation by means of the Merrill-Crowe process.

G. Newton Kirsebom, in the Nov. 19, 1927, issue of *Engineering and Mining Journal,* proposes a process for the treatment of silver sulphide precipitate by fusion with caustic soda. This process possesses possibilities, and it might be suggested that it could be used in conjunction with the precipitation of gold by means of activated char. In regard to the latter method of gold recovery from cyanide solution, nothing appears to have been done since the researches of R. H. McKee and P. M. Horton, published in *Chemical & Metallurgical Engineering* early in 1925. The process developed by S. B. McCluskey in Mexico for the treatment of manganese-silver ores, involving the use of SO_2 gas direct in the cyanide solution and the recovery of the cyanogen released, has been under trial at Fresnillo. The process depends for its economic success on the availability, at low cost, of a supply of sulphur, for the manufacture of the gas.

Pyrometallurgy—Lead and Copper

By E. H. ROBIE
Associate Editor

THOUGH developments in hydrometallurgy and in the concentration of ore by flotation have received somewhat more publicity in the last year or two than has the progress made in pyrometallurgy, it must not be inferred that fire methods are being displaced or that operators of such plants are not improving their practice. New copper and lead smelters are being built every year, 1927 being no exception, and many improvements are constantly being made in the equipment of the old ones. Much interesting work of a pioneer nature is being conducted in the metallurgy of zinc, which Dr. Ingalls will discuss further on. The metallurgy of some of the minor metals has also been improved with the building of new plants or the modernizing of those already existing.

Another year has passed in which copper metallurgists have been forced to get most of their information concerning progress in the art of smelting by word of mouth. The Carson litigation continues, and few smelter managers in the United States are willing to allow any data regarding their reverberatory operations to be published, —a temporary condition, of course. Ten or fifteen years ago it was said that many of the flotation plants were being run according to the best legal practice, and the same statement applies to much reverberatory smelting today. Details of current practice, therefore, cannot now be printed, but I can say that a great deal of work of much promise is being done in the center-feeding of reverberatories, instead of along the side walls; in water-cooling the roof arches and side walls; in the use of different refractories and more basic slags; and in developing improved charging practice.

George C. Carson started his first suit, for the infringement of his patent for side-feeding reverberatories, against the Afterthought Copper Company, in 1921, and the jury apparently tried to suit everybody by holding the defendant guilty but assessing damages of only $1. The American Smelting & Refining Company was next sued for its practice at the Tacoma smelter, but it was held that the Carson patents were antedated by the Siemens patents, and were therefore void, a decision that was reversed on appeal, the U. S. Supreme Court afterward refusing to review the decision. An accounting is therefore now being made by officials of the A. S. & R. covering all of its plants at which infringement was alleged. In 1924, suit was brought by Carson against Anaconda, which was decided, two years later, in favor of that company. An appeal was heard in San Francisco in November, 1927, but a decision has not yet been made as this is written; nor has any decision been made in the Carson suit against Phelps Dodge and Calumet & Arizona, which was heard in the early fall of 1927. Another year may see this litigation wound up.

Two important copper-smelting plants that were blown in during 1927 were those of the Andes Copper Company, an Anaconda subsidiary in Chile, which, at the end of the year, had one of its three reverberatories operating, producing about 2,500 tons of copper a month; and the Horne Copper Corporation (Noranda), at Noranda, Quebec, with a capacity of 1,000 tons of ore a day. The last-named plant is of interest for several reasons. In the first place, it is one of the few plants in the world that is smelting run-of-mine ore in reverberatories, though milled custom ore is likely to be accepted later. Concentration is not necessary, because the ore is high-grade: around 7 per cent copper and $5 in gold and silver, the minerals being chalcopyrite, pyrrhotite, and pyrite. After being crushed in jaws, gyratories, and rolls to $\frac{1}{4}$ in., the ore goes to eight 25-ft. Wedge roasters, there being 34 bins over the roasters, with a capacity of 5,000 tons. Thus ample storage is provided to compensate for any irregularity in the receipt of ore at the smelter or a breakdown in the crushing or conveying equipment; and, furthermore, the heat from the furnaces can be turned to good advantage in warming the ore and preventing troubles that result through freezing in the feed hoppers. Two reverberatory furnaces, each 25x100 ft. inside, are provided, with side-charging and powdered-coal firing; two Peirce-Smith converters, 12x26 ft.; and two casting machines. There is a steel-plate type Cottrell plant for the roaster and converter gases, and a 422½-ft. reinforced-concrete stack, 18 ft. inside diameter at the top and 25 ft. at the base, with a 4-in. brick lining.

A novelty in connection with the Noranda reverbs is the use of heat recuperators. The idea is not new, of course, for, at the old Boston & Montana smelter at Great Falls, regenerators were used in connection with Taylor producers years ago, and in steel practice such devices are common. Also, at the Kyshtim smelter, in Russia, a brick checkerwork was used before the World War to save waste heat; and Walter G. Perkins, of London, tried hard afterward to sell the idea to metallurgists on this side of the water. But at Noranda a brick checkerwork is not used, the heat transfer being made through a nickel alloy, patented and developed by Victor Hybinette, of Wilmington, Del. It will be interesting to see how the idea works. Archer E. Wheeler, consulting metallurgist, tells me that in the first few days the incoming air for the burners had a temperature of 1,000 deg. F. Waste-heat boilers are not so valuable adjuncts to the smelter here as they are at Southwestern plants, for electric power is cheap and plentiful.

Hurriedly crossing the continent to Trail, B. C., one finds that the Consolidated Mining & Smelting Company has built an 18x60-ft. powdered-coal-fired reverberatory for smelting the wet copper concentrates from the Allenby mill, carrying 10 per cent moisture. The Hardinge unit system is used for grinding and delivering the coal to the furnaces, whereas Wheeler used the Holbeck system at Noranda. The concentrate is mixed with a little old tailing, and consists of about 29 per cent copper and 16 per cent sulphur; this makes a 40 to 45

per cent matte, and a slag containing about 40 per cent silica, 21 per cent iron, and 11½ per cent lime. About 300 tons per day is thus smelted. It may be remembered that a similar practice of smelting wet unroasted concentrates at Cananea was described in *Engineering and Mining Journal* in 1926. It would appear to be approved practice now where no great sulphur elimination is desired and to be in favor for the high-grade concentrate now made by selective flotation. This work recalls the tests that were carried out some years ago at Anaconda by Messrs. Klepinger, Krejci, and Kuzell, in which concentrates were blown into a converter. Though successful in many respects, the practice has never been tried out on a commercial scale.

The new roaster-reverberatory installation of the Copper Queen smelter of the Phelps Dodge Corporation was put into service early in 1927. This consists of two reverbs above which are superposed twelve "Queen" type 11-hearth insulated roasters, which discharge their calcines by gravity to the smelting furnaces at a temperature of 1,200 to 1,400 deg. F., an idea that has worked out most successfully here for the first time. Increased reverb tonnage and high fuel ratios are secured. The roaster gas passes to a pipe-type Cottrell treater, and the reverb gases go to eight 500-hp. waste-heat boilers. Mention of boilers reminds me that Nevada Consolidated has installed two 1,124-hp. boilers in connection with a new reverberatory built during the year, boilers of large size being held to be much more efficient. The flues leading to the waste-heat boilers at this plant slope slightly (about 1 in. per foot), so that the smelted dust may run back into the furnace.

Blast-furnace smelting of oxidized copper ores by the Katanga company, in Africa, is now supplemented by smelting in a reverberatory furnace, the ore and flux being mixed with a small amount of coal for the purpose of reduction. Powdered coal is used as fuel and a reducing atmosphere is maintained. Results have not been reported in detail, but it is probable that economies will be effected over the old blast-furnace treatment, which was especially wasteful because of a high slag loss. Blast furnaces for copper smelting continue to fade out of the picture. Few plants now use them, even though they may remain installed. During the year, the United Verde went over entirely to reverberatory smelting, following completion of its new concentrating plant. Excellent work was done with the United Verde blast furnaces too, as low as 4 per cent of coke on the charge being obtained. Sintering of a fine charge, in order to utilize existing blast-furnace equipment, was tried by the International Nickel Company and given up.

A special heat-resisting alloy has been used for the rabble blades and heads on the fifth and hottest hearth of one of the Nevada Con. roasters. Though installed last July, the alloy seems to be standing up to the service perfectly, and has been very satisfactory. The use of vitrified brick and crushed magnesite brickbats from the converter department in the mortar used in laying up the roaster hearths at this plant is worthy of mention, though the practice has been in use for some time. Mortar so made takes an extremely hard set, making a most satisfactory hearth which has cut down hearth renewals by half.

Converting practice has undergone little change. The United Verde is reported to have resumed basic converting after a brief trial with acid linings in an effort to improve the practice of twenty years ago. A more successful revival of old practice has been accomplished at the Hubbell (Mich.) works of the Calumet & Hecla, where native copper concentrates are melted and the molten copper is transferred to a separate furnace for refining. A separate melting furnace is used similarly at the Laurel Hill refinery of the Nichols Copper Company, in New York City. Powdered coal continues to displace oil as fuel for the anode and wirebar furnaces at copper refineries.

Improvements in flotation have changed practice at lead smelters, the ore they now have to treat being not only of higher grade but containing less zinc and other impurities than formerly. As a result, from one-half to two-thirds of the lead furnaces at most smelters are idle. On the other hand preliminary treatment is more complicated.

The only new lead smelter of importance to be constructed in the United States during the year was that of the Phelps Dodge Corporation, at Douglas, Ariz. This consists of an automatic sampling and crushing plant, a nine-hearth roaster, blast furnace, storage bins, sintering machine, lead kettles, casting machine, and baghouse, all being designed by A. G. McGregor.

A new lead refining plant has been installed by the National Lead Company, in Buenos Aires, and new casting equipment has been designed and installed by the U. S. S. Lead Refinery at Grasselli, Ind., mechanizing the operations as was done by W. E. Newnam at the Collinsville plant some years ago. The Harris process has been further developed at the A. S. & R. refinery at Perth Amboy, N. J., and it is probable that at this plant this English process has received its highest development. A full report on the work is awaited with interest. The 90-ton remelting kettle installed by the U. S. Smelting company at its Midvale plant about a year and a half ago has given excellent results, no repairs having been necessary so far. The kettle is supported by steel columns instead of the brickwork of the furnace and is especially well insulated for economy in fuel.

The Trail smelter has installed a new Cottrell treater for the gas from the Dwight & Lloyd sintering machines. Cedar wood has been found especially resistant to the acid fume and has been used in construction wherever possible. A much greater capacity for the D. & L.'s at this plant has been secured by increasing their length from 264 to 600 inches.

Reference to Dwight & Lloyds recalls the suggested use of these machines for treating quicksilver ore, in place of the Scott or Gould furnace. With the present high price of quicksilver, several deposits of ores of that metal are being developed, and the use of a sintering machine might well be considered. The application has been successful on a laboratory scale, the ore or flotation concentrate being mixed with 4 or 5 per cent of coal, and a rich gas, small in volume, resulting. The same type of equipment has been installed by the Aluminum company, in Quebec, for calcining bauxite, preparatory to electric smelting.

More work is being planned by the U. S. Bureau of Mines on the physics of the important mineral substances in smelting; this will be carried on at the Berkeley station. Research work is also to be done by the Bureau on the heats of formation and specific heats of important compounds of interest in copper and lead smelting.

Pyrometallurgy—Zinc

By W. R. INGALLS

THE metallurgy of zinc has been experiencing something like a revolution during the last two years, although we must not be too specific in respect to time, metallurgical changes always being gradual. The change in zinc metallurgy that is now in process is partly ascribable to the pressure of competition in an overbuilt industry and partly to the general introduction of the new process of selective flotation for the beneficiation of lead-zinc and lead-zinc-iron ores. This process was introduced in 1921, but for two or three years it did not attract general attention. With its aid almost any ore of this character that had previously been considered as rebellious became amenable to beneficiation. About 1925 there was an expeditious application of this process in many places.

The flotation concentrate comes to the smelter in the form of a sticky mud, which when dry becomes a fine-grained dusty material more or less of the physical nature of wheat flour. With their previously existing arrangements, smelters were not equipped easily to handle either the mud or the flour. The former condition introduced physical difficulties; the latter entailed serious loss of ore by dusting.

Previous to 1927 the smelters worked off this new material in conjunction with their previously normal ore and so carried it through their process with reasonably fair results. The treatment of such material occurred mainly in Oklahoma, where the roasting is done on single-hearth furnaces, the dusting from which is naturally least. With the beginning of 1927 the supply of flotation concentrate had so increased that some smelteries had to be put upon an all-flotation basis, and the difficulties then became emphatic, especially if the roasting had to be done in multiple-hearth furnaces and in connection with the manufacture of sulphuric acid as a byproduct.

These difficulties are by no means insuperable, and in the end it will be found that it has been an economic blessing that metallurgists were constrained to face. The trouble has been that smelters, having previously refused to modernize their plants and practices, became finally constrained to do so. Obviously this necessitates large capital expenditures.

The modernization of plant in America is taking the form of the substitution of roasting furnaces of the Ingalls-McDougall type, not trying to roast completely in them but finishing the desulphurization by sintering on Dwight-Lloyd machines and collecting the dust raised in the preroasting by means of a Cottrell electrical precipitation plant.

The furnaces of the Ingalls-McDougall type being adopted are the Herreshoff, Wedge, the O.R.D. or Webb-Wedge, and Skinner, which are essentially the same in principle, differing chiefly in structural details and proportions. A new tendency is in evidence to increase the number of hearths of these furnaces, even up to sixteen, instead of about eight, the idea being to increase the roasting effect while the particles of ore are in suspension—i.e., as they fall through the drop holes. Even with an eight-hearth furnace the dusting is large, and some subsequent and adequate precipitation is an essential condition.

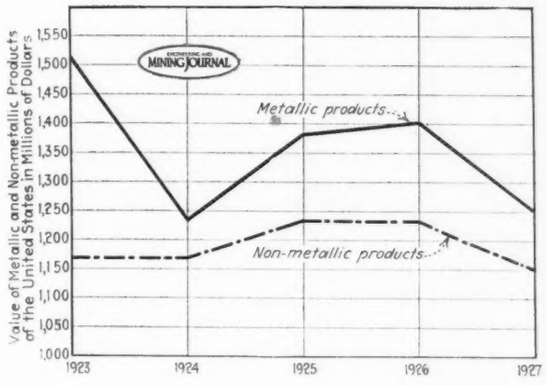
In principle, the present program for desulphurization follows the process developed by the Vieille Montagne metallurgists at Baelen, in Belgium. The ore, reduced to about 2 per cent sulphur in the roasters, is cooled, is mixed with about 5 per cent fine coke, is moistened, and is then sintered on Dwight-Lloyd machines, which if properly run effect a high degree of desulphurization, besides improving the physical condition of the ore. This is an abandonment of the original Rigg & McBride idea of preroasting to about 8.5 per cent sulphur and then sintering. Our thoughts may revert to that later. In the meanwhile, the Baelen process keeps the cost of roasting at about what it used to be and makes the cost of sintering a direct addition. The benefit has to be, therefore, in a much offsetting performance in distilling, which in fact is realized for reasons that the limits of this article do not permit me to discuss.

I am constrained also to make no more than passing reference to the use of carborundum retorts in some works, and an increased attention to that subject; to tentative trials of vertical retorts; to experimentation with the Coley and Ashcroft-Lacell processes in Europe; and other novelties that have not yet been proved in practice.

Apart from the new method of desulphurizing blende, the major development in the pyrometallurgy of zinc has been the extensive introduction in Europe of the Waelz process, which is a form of what I have previously characterized as zinc burning—i.e., the reduction of zinc oxide in a rough way and immediately burning the reduced zinc, subsequently collecting the zinc oxide fume. In the Waelz process this operation is performed in a revolving cylinder like a cement kiln. Another process of zinc burning has been introduced by the Anaconda Copper Mining Company, for the treatment of zinky slag at East Helena, Mont. In this process the reduction and burning are performed in a special furnace, powdered coal being blown in through the tuyeres.

The electrolytic extractors, who work with a relatively new process and were already equipped to treat excessively fine ore, have not had the difficulties confronting distillers possessing old plants. The production of electrolytic zinc has, therefore, continued to forge ahead, and this has had a tremendous effect in the market. Among the older plants the electrolytic practice is now well standardized. The new plant of the Sullivan Mining Company at Kellogg, Idaho, is to give the first demonstration on a large scale of Tainton's methods, involving the use of much higher current density and much more strongly acid solutions than are employed in regular practice.

UNITED STATES



Output and Value of Metals and Non-metallic Minerals Decrease, but Dividends Are Higher

By H. D. Keiser
Assistant Editor

PRELIMINARY estimates for the United States indicate that in 1927 the valuation of metallic and non-metallic production declined from $2,634,720,000 to about $2,400,000,000 or approximately 9 per cent. Metallic output is valued at $1,250,000,000, representing a decrease of about 11 per cent, compared with the 1926 value of $1,402,920,000. Value of non-metallic production is placed at $1,150,000,000, which is a decrease of about 6½ per cent compared with the 1926 figure of 1,231,800,000.

Production of the principal metals decreased about as follows: Zinc, 4 per cent; lead, 3 per cent; pig iron, 7 per cent; gold, 6½ per cent; silver, 6½ per cent; and copper (from United States mines), 5 per cent. This decreased metal production was accompanied by a practically parallel curtailment in the metal-mining operations of the country. Lower prices for mine products were the primary cause of the general decline in production. A lessened demand for metals on the part of the other industries, and decreased operation costs, owing chiefly to further mechanization of underground operations and to continued improvement in metallurgical practice, were the outstanding factors contributing to the lowering of metal prices. The general condition of the metal-mining industry, on the basis of dividends disbursed, however, was quite satisfactory, total payments for 1927 being slightly in excess of those of the preceding year.

Alabama — Iron-ore production in Alabama decreased about 5½ per cent in 1927, 6,473,000 tons being mined, compared to 6,847,789 tons in 1926, according to estimates prepared by the U. S. Bureau of Mines. Output of the non-metallic mining industries of the state was practically the same as that for the preceding year.

Alaska—The Department of the Interior announces, through advance statements prepared by the Alaskan branch of the U. S. Geological Survey, that mines in Alaska produced minerals to the value of $14,445,000 in 1927, as against $17,664,800 in 1926. The source of this mineral wealth is approximately as follows:

	1926	1927[a]
Gold	$6,707,000	$6,010,000
Copper	9,489,000	7,280,000
Silver	430,000	320,000
Coal	459,000	495,000
Other minerals (including lead, petroleum, marble, tin, and platinum)	579,300	340,000
Totals	$17,664,800	$14,445,000

[a] Estimated.

Although, as shown by the preceding table, the value of Alaska's mineral production was considerably less in 1927 than in 1926, this decrease in value is by no means to be attributed solely to decreased mining activity. A considerable part of the decrease noted is directly due to the low price that prevailed during the year for many of the metals.

Arizona—Production at the Arizona mines in 1927 continued uninterruptedly throughout the year. The total copper output for the twelve months will probably only slightly exceed that of 1926, owing to the fact that in the early months curtailment was practiced at a number of properties, the New Cornelia Copper Company reducing its output in February; and in May and June the Inspiration Consolidated, Magma, and Ray were all operating at reduced capacity. The increased price of copper in the last three months of the year has encouraged the copper companies to maintain a good rate of production, New Cornelia even putting on a third, or "graveyard," shift, for the first time in its history.

The outstanding events of the year in the mining industry in the state were: the blowing in of the remodeled copper smelter at Douglas by the Phelps Dodge Corporation; completion of the Phelps Dodge lead flotation concentrator at Bisbee; remodeling of the Humboldt concentrator as a custom concentrator for the treatment of complex ores, by Phelps Dodge Corporation; successful operation of the Inspiration Consolidated Copper Company's leaching plant; reopening of the Montana mine, at Ruby, by the Eagle-Picher Lead Company, and the breaking ground for the construction of a 150-ton flotation concentrator; the sinking of two large new shafts in the Bisbee district, one by Phelps Dodge and the other by the United Verde Extension, which shafts mark the initiation of an era of development work for the expansion of the ore-bearing zones of the district; the completion of the United Verde Copper Company's 1,000-ton flotation concentrator at Clarkdale, in May, for the treatment of lower-grade schist ores; and the complete electrification of the steam-shovel equipment, including churn drills, at the steam-shovel pit of the United Verde Copper Company.

Arkansas—A partly complete statement of the mineral production in Arkansas during 1927 indicates an increase in output of clay, sand, gravel, and stone, and a decreased production of bauxite and manganese. The outstanding development in the metallic mineral field was the erection of a test plant near Batesville for the purpose of developing a process whereby the large low-grade manganiferous deposits in the district might be beneficiated. Zinc and lead production was small, only three properties being operated. Bauxite operations proceeded steadily throughout the

year, although no new developments of large size were undertaken. Both the American Bauxite Company and the Superior Chemical Company continued with the development of their properties; the Globe Bauxite Company curtailed production, and the Southern Bauxite Company closed down its operations.

California—The value of gold, silver, copper, lead, and zinc produced at mines in California in 1927, according to the U. S. Bureau of Mines, was $16,768,500, a decrease of $3,282,301 or 16 per cent compared with the value of metals produced in 1926. There were apparently decreased yields of about 2 per cent in gold, 30 per cent in the value of silver, 26 per cent in the value of copper, 73 per cent in the value of lead, and 66 per cent in the value of zinc produced compared with the previous year.

Of the various Mother Lode properties the active mines were the Kennedy, Argonaut, Central Eureka, Plymouth, and Moore. Several smaller properties made preparations for working. At Grass Valley, the North Star, Empire, and Idaho-Maryland operated throughout the year, the North Star being in a better position than in 1926, the Empire laying off part of its working crew toward the end of 1927, and the Idaho-Maryland continuing upon an improved status after acquiring its neighbor, the Brunswick. At Alleghany, the Sixteen-to-One operated as usual, with about the same production. A number of smaller mines operated in this region. In gold dredging, the Estabrook dredge in Trinity County was closed down, probably permanently. The Lewiston and Smith dredges remained in operation, and construction of another dredge was begun upon the Trinity late in 1927. At Hammonton, six dredges were operated and at Natomas, likewise, six. In all, nineteen dredges were in operation. One dredge was installed by the Capital Dredging Company, and another is to be constructed. Thus the number of dredges remained about the same as in 1926. Value of gold production from both lode and placer properties decreased from $11,923,481 in 1926 to $11,738,600 in 1927. Silver production, which was 2,002,460 oz. in 1926, decreased to 1,457,310 oz. Copper was produced by only four companies, the Engels, Walker, Island Mountain, and the Mason Valley Mines Company from its Balaklala lease in Shasta County. The Calaveras Copper Company shut down in January, and therefore made only a small production. Activity in lead mining was nominal as well as in zinc. The California Zinc Company shut down its Winthrop operations during the year. Inyo County and the desert region were active and some new discoveries were reported. Cerro Gordo is shut down, however, and Darwin is not over-active Generally, the desert sections have not greatly advanced over their 1926 positions. Quicksilver mining improved, and increased production over that in 1926 is to be expected.

A greater and growing interest is being taken in non-metallics. Structural materials, building stone and clay products, all originating in quarry operations, totaled more than $54,000,000 in value in 1926 and may be expected to slightly exceed this figure in 1927. Non-metallic minerals approximated $10,000,000 in value in 1926 and will exceed this in 1927. Of this amount about half is in minerals used in, or produced by, chemical industries. Barytes, borates, magnesium salts, potash, pyrites, soda, and salt are now products of well-established industries. Clays for filtering and decolorizing purposes showed an increased production, which will continue to increase.

Estimates of Iron Ore Mined and Shipped in the United States in 1927 and Actual Output in 1926

U. S. Bureau of Mines

District	Ore Mined (Gross Tons)		Ore Shipped			
			1926		1927	
	1926	1927	Gross Tons	Value	Gross Tons	Value
Lake Superior						
Michigan	15,248,254	15,203,000	16,699,984	$43,932,982	14,685,000	$37,757,000
Minnesota	40,701,613	35,398,000	40,961,361	103,715,621	35,558,000	90,289,000
Wisconsin	1,322,776	1,090,000	1,238,885	3,178,156	940,000	2,407,000
	57,272,643	51,691,000	58,900,230	$150,826,759	51,183,000	$130,453,000
Southeastern states						
Alabama	6,847,789	6,473,000	6,871,412	$13,846,656	6,505,000	$13,021,000
Georgia	51,642	50,000	51,642	149,198	50,000	136,000
Missouri	124,371	83,000	124,371	532,536	83,000	369,000
North Carolina	15,198	33,000	14,798	31,645	33,000	82,000
Tennessee	138,819	124,000	138,307	312,109	124,000	279,000
Virginia	49,159	69,000	49,703	162,446	71,000	129,000
	7,226,978	6,832,000	7,250,233	$15,034,590	6,866,000	$14,016,000
Northeastern states						
New Jersey	209,117	219,000	212,152	$925,403	198,000	$834,000
New York	638,849	850,000	659,741	3,015,586	939,000	4,276,000
Pennsylvania	1,095,505	1,179,000	1,088,634	2,483,056	1,132,000	2,539,000
	1,943,471	2,248,000	1,960,527	$6,424,045	2,269,000	$7,649,000
Western states	1,179,908	1,007,000	1,181,842	$1,730,251	1,007,000	$1,523,000
Grand totals	67,623,000	61,778,000	69,292,832	$174,015,645	61,325,000	$153,641,000

Colorado—The output of gold, silver, lead, copper, and zinc from Colorado mines in 1927 in terms of recovered and estimated recoverable metal was 259,245 fine ounces of gold, 3,792,206 oz. of silver, 67,566,000 lb. of lead, 5,745,000 lb. of copper, and 74,874,000 lb. of zinc, according to the U. S. Bureau of Mines. These figures are to be compared with 334,339 fine ounces of gold, 4,624,000 oz. of silver, 66,000,000 lb. of lead, 3,350,000 lb. of copper, and 65,000,000 lb. of zinc in 1926. Compared with the 1926 figures, gold shows a decrease of 75,094 oz. or $1,552,335, silver a decrease of 832,000 oz., lead an increase of 1,566,000 lb., copper an increase of 2,395,000 lb., and zinc an increase of 9,874,000 lb. The gross estimated value of the output of metals in Colorado in 1927 is: Gold, $5,359,070; silver, $2,150,181; lead, $4,574,218; copper, $746,850; zinc, $4.702,087, a total of $17,532,406, compared to $20,482,081 in 1926.

Georgia—Early estimates of the mineral output of Georgia indicate that the 1927 output will show a considerable increase over that of the previous year, which was valued at $19,149,903. In the clay industry, especially, a notable increase is predicted. The Cartersville district continued to be the largest producing field, the minerals being barite, ocher, lime, and limestone.

Idaho—The value of the gold, silver, copper, lead, and zinc produced from ore mined in Idaho in 1927, according to the U. S. Bureau of Mines, was about $28,469,000, compared with $30,969,551 in 1926. Despite the decline in metal prices there was a decided increase in the output of silver and lead and a slight increase in gold and copper. A small decrease in zinc resulted from unusual local market conditions.

The most outstanding feature of 1927 in the mineral industry of the state was the activity displayed in development of new properties or of properties which have been dormant for many years. Few of these properties, however, reached the productive stage.

In the Coeur d'Alene district, 1927 silver production will be about the same as that of 1926. Most of the silver produced is a byproduct of lead, and as there was a decrease in lead production, it would naturally follow that there would be a corresponding decrease in silver. However, it is believed that the rich silver ore shipped by the Sunshine Mining Company will offset this decrease. Lead production will probably show a decrease of 10 per cent, which is accounted for mainly, if not altogether, by curtailment of output by the Hecla Mining Company. The zinc output for the year will show a decrease of 25 per cent—possibly more—owing to discontinuance of shipments early in the year by the Star, Highland-Surprise, Douglas, Tamarack, and Success mines. Copper production will be about the same as 1926. The total value of mineral output will be considerably below that of 1926, on account of lower metal prices. By far the most important event

in connection with mining in the district during 1927 was the construction of the electrolytic zinc plant by the Sullivan Mining Company (Bunker Hill and Hecla), at Kellogg. The unit under construction, which is nearing completion, will be capable of turning out 50 tons of metallic zinc per day. Its completion will be followed by construction of two more units of the same capacity.

Joplin-Miami District—Lower prices for lead and zinc concentrates were responsible for a marked reduction in output of both in the Joplin-Miami district during 1927. Production of zinc concentrate declined 148,488 tons, or 17.7 per cent, and lead concentrate 26,701 tons, or 20.4 per cent, compared with 1926 production. A record of shipments from the field during the year 1927 follows:

Zinc Concentrate

	Tons	Value
Oklahoma	433,902	$17,834,369
Kansas	215,138	8,854,273
Missouri	39,997	1,648,275
Totals	689,037	$28,356,917

Lead Concentrate

	Tons	Value
Oklahoma	71,905	$6,254,640
Kansas	29,533	2,576,064
Missouri	2,661	231,076
Totals	104,099	$9,061,780
Total value, lead and zinc concentrates, 1927		$37,398,697
Total value, lead and zinc concentrates, 1926		54,923,446
Total value, lead and zinc concentrates, 1925		59,415,585

Lower prices, as mentioned above, were primarily responsible for the reduced output. The comparative production possibility of the field is quite as great as ever, or very nearly so. In 1926, the highest price paid for zinc concentrate was $56, at the beginning of the year, and the lowest price, $45. In 1927, the highest price was $46 and the lowest $35. The average price in 1926 was $48.83, and for 1927 it was $41.12. In 1926, the highest lead concentrate price was $122.50 and the lowest $92.50. In 1927, the highest price was $100 and the lowest $75. The average price in 1926 was $105.20, and for 1927 it was $87.05. Price of zinc concentrate was $46 a ton at the beginning of the year and showed a gradual retrogression most of the year, reaching its lowest figure, $35, in November. Lead concentrate prices started at $97.50, climbed to $100 after about two months, then slowly dropped to $75 soon after the middle of the year, and stood at $80 for more than two months, advancing to $85 at the close of the year.

Under these conditions great development activity was not recorded. There was less drill prospecting and less mill building in the district in 1927 than for several years. Necessity for more economic production, however, resulted in improved milling practice, particularly in re-treating tailings and slimes. Numerous mills were transformed into tailing plants, and particular attention was given to improving sludge mill recoveries. Several of the larger companies have acquired considerable acreages in new or recently quiescent portions of the field, but have exhibited little enthusiasm in pushing development therein. Some worked-out mines were closed, as is the condition each year, and several new developments on abandoned tracts of land were made.

The new electrolytic zinc plant at Kellogg, Idaho

Property sales were slow, comparatively few being recorded. The largest deal of the year was that wherein L. P. Buchanan and the Barnsdall Zinc Company turned their Waco properties over to the Missouri-Kansas Mining Company for a total consideration of over a million dollars.

Lake Superior Iron Ranges—Mining operations on the Lake Superior iron-ore ranges were not as extensive during 1927 as in the preceding year. Shipments by water amounted to 51,107,136 tons, against 58,516,876 tons in 1926. To the Lake shipments must be added about 1,500,000 tons shipped all-rail to furnaces of the Middle West.

Shipments by ports for the year were as follows:

Port	Tons
Escanaba	5,865,224
Marquette	3,338,855
Ashland	6,239,874
Superior	14,627,936
Duluth	15,432,188
Two Harbors	5,703,159
Total	51,107,136

Many of the mines on the Michigan ranges were worked only five days a week; this was particularly true of mines operated by the Cleveland-Cliffs Iron Company and Pickands, Mather & Company. Greater use of scrapers and hoists underground did much to add to production, and many of the mines working on reduced schedules were able to obtain as much ore as formerly. Some were even able to almost double output with no increase in working forces.

Michigan Copper District—Total output of the Michigan copper district in 1927 is estimated to have been 177,500,000 lb. of refined copper. This compares with 175,441,565 lb. in 1926. The Calumet & Hecla mines and Mohawk showed an increase in output for the year, but Quincy, as a result of a fire in one of its two producing shafts, showed a decrease. Seneca suspended operations on June 30. Copper Range and Isle Royale maintained their 1926 average production rate.

Montana—The value of gold, silver, copper, lead, and zinc produced from Montana mines in 1927, according to the U. S. Bureau of Mines, was $48,078,000, a decrease from $59,410,453 in 1926. The curtailment of operations at Butte, together with the decrease in metal prices, resulted in a general decrease in the quantity and value of the five metals. A decrease of about 12 per cent was shown in the output of copper, and there was a corresponding decrease in the production of the associated gold and silver.

In the Butte district, the Anaconda company installed and started in operation the third of three 5,000-ft. electric hoists, which are in use at the Badger, Mountain Con., and Belmont shafts. At the Washoe plant, in Anaconda, several changes were made in the copper concentrator and smelter, and a new electrolytic zinc refinery was constructed, with capacity of 10,000,000 lb. per month. Butte & Superior completed its shaft from the 3,400- to the 3,600-ft. point, carrying a smaller than standard shaft, which, on account of good developments, will be enlarged to standard size. North Butte, which had been operating its "hill" properties on the leasing system, closed down during the latter part of the year, owing to a disagreement among directors and officers. Domestic Manganese and Development

Company installed magnetic concentrators and roasting kilns at its new plant, the former Butte Reduction Works. In the southwest portion of Butte, important lead-zinc-silver developments were made by Ardsley Butte Mines Corporation and Butte Independent Mines Company. The Otisco property in the south central part of Butte shipped considerable ore, under supervision of the Lewisohn interests.

In the Helena district, a slag-treatment plant was erected by the Anaconda Copper Mining Company to treat the slag dump and current slag for its metallic content, the chief object being to recover the zinc content of the slag. At East Helena the plant of the American Smelting & Refining Company was enlarged and improved, and was operated at capacity. Important mining operations were carried on by the Montana-Idaho Mines Corporation, operating three producing properties and two mills near Winston, and opening the old Spring Hill property at Unionville.

Nevada—The value of gold, silver, copper, lead, and zinc in Nevada decreased from $24,549,991 in 1926 to about $22,948,000 in 1927, according to a preliminary statement prepared by the U. S. Bureau of Mines. There was a decided increase in the output of copper, but the other metals, especially gold and silver, decreased. The increase in copper, equivalent to about $1,000,000, was not sufficient to balance the other decreases, especially since the average metal prices were much less than those of 1926.

As indicated in the table shown below, production in the Tonopah district decreased slightly during the year 1927. This decrease was accentuated in the total value of the output by the lower price received for silver.

	1926	1927
Tons of ore produced	138,031	131,857
Gross value	$2,000,247	$1,793,265
Gross value per ton	14.49	13.60
Recovered ounces, gold	26,318	25,749
Recovered ounces, silver	2,365,159	2,273,309

Milling practice and extraction did not change, gold recovery averaging about 95 per cent and silver extraction 93 per cent. The Tonopah Divide Mining Company, which owns the old Midway mine in the Tonopah district, ceased operations in that property. The West End Consolidated Mining Company closed its 265-ton plant in October, and shipped a reduced tonnage to the Tonopah Mining Company's plant at Miller's.

In Lincoln County, the output of the three largest producers—the Combined Metals Mining Company, Black Metals Mining Company, Bristol Silver Mines Company—slightly exceeded 48,500 tons. Production from miscellaneous small producers was approximately 700 tons, the Tempiute Mines Company being the principal shipper.

New Mexico—The estimated value of the output of metals in New Mexico during 1927, according to statistics compiled by the U. S. Bureau of Mines, was $15,491,396, compared with $14,481,808 in 1926, an increase of $1,009,588, or 7 per cent. Itemized production of the various metals for the last two years follows:

	1926	1927
Gold, ounces	19,631	27,079
Silver, ounces	450,934	857,547
Lead, pounds	6,960,366	15,500,000
Copper, pounds	81,642,379	77,000,000
Zinc, pounds	24,104,800	53,600,000

The increases shown for gold, silver, lead, and zinc are all attributable to the production of the American Metal Company's mine, on Willow Creek, in San Miguel County.

New York—Very few changes occurred in the mining industry of New York. Estimates indicate that production in 1927 will not greatly exceed that of 1926, although total valuation may decrease, owing to lower prices, particularly those for clay products. The Clinton hematite mines, at Clinton, Oneida County, were acquired by the Clinton Metallic Paint Company, operating the adjoining hematite properties. The Adirondack Garnet Products, Inc., began the mining of garnet in the town of Minerva, Essex County.

Oregon—The value of gold, silver, copper, and lead produced in Oregon in 1927, according to the U. S. Bureau of Mines, was $365,000, an increase of $30,260 or 9 per cent compared with the value of metals produced in 1926. The largest increase—58 per cent—was in the value of copper produced. Gold increased 3 per cent, but the value of silver decreased 3 per cent, due to lower price of the metal, and the value of lead decreased 68 per cent, owing to smaller production and lower price.

North Carolina—As shown in the tabulation below, the mineral production of North Carolina increased about 14.6 per cent in total valuation in 1927. Material gains were made by the granite, iron ore, limestone, quartz, and talc operations.

	1926	1927*a*
Brick and tile	$4,235,653	$4,500,000
Kaolin clay	331,487	350,000
Coal	243,000	250,000
Copper *b*	*b*	*b*
Cements products	529,818	600,000
Feldspar	602,020	700,000
Granite	3,802,017	4,500,000
Iron ore	53,045	60,000
Limestone, marble, marl	338,811	400,000
Manganese *b*	*b*	*b*
Mica	204,410	225,000
Quartz	35,914	50,000
Silver and gold	1,644	2,000
Sand and gravel	968,021	1,000,000
Talc and soapstone	97,004	150,000
Miscellaneous	177,181	500,000
Total	$11,600,025	$13,287,000

a estimated.
b included in miscellaneous.

South Dakota—Further improvement was made by the mining industry of South Dakota during 1927. The Homestake Mining Company milled a total of 1,370,000 tons, recovering gold and silver valued at $6,725,000—the largest output of the company in recent years.

Southeast Missouri—Output of lead in the southeast Missouri field was slightly less than in 1926; zinc production, however, showed a large gain. The principal operations in the district, as heretofore, were those of the St. Joseph Lead Company, Desloge Consolidated Lead Company, and the St. Louis Smelting & Refining Company. St. Joseph Lead Company reopened Mine La Motte, in Madison County.

Tennessee—The copper mines of the Ducktown district operated through 1927, but on a reduced basis compared with 1926. Production of the Tennessee Copper & Chemical Corporation declined about 11 per cent, output being 5,596 tons in 1927 and 6,283 tons in the preceding year. Ducktown Chemical & Iron Company constructed a 300-ton milling plant at the Isabella mine.

Texas—Minerals and mineral products obtained in Texas during 1927 had a total estimated value slightly in excess of $325,000,000, compared with a total value of approximately $375,000,000 for 1926, according to statistics compiled by Dr. E. H. Sellards, director of the Bureau of Economic Geology of the University of Texas, in co-operation with the U. S. Bureau of Mines.

Utah—Notwithstanding lower metal prices and undiminished operation costs, Utah mines enjoyed during 1927 a period of comparative prosperity. Although earnings were not as great as during 1926, with but few exceptions Utah non-ferrous mines were able to meet dividend requirements. Extension of productive areas in old properties, important discoveries in new mines, in-

Gold and Silver Production of the United States in 1927

The Bureau of the Mint, with the co-operation of the Bureau of Mines, has issued the following statement of the preliminary estimate of refinery production of gold and silver in the United States during the calendar year 1927:

States	Gold, Oz.	Silver, Oz.
Alaska	282,873	556,825
Arizona	207,064	6,666,386
California	567,855	1,457,310
Colorado	254,869	3,636,505
Georgia	15	4
Idaho	14,024	8,674,588
Illinois	.....	1,500
Michigan	.....	51,742
Missouri	.....	100,210
Montana	56,221	11,497,935
Nevada	144,564	5,308,720
New Mexico	26,321	762,809
North Carolina	5	.....
Oregon	13,492	31,024
Pennsylvania	97	1,974
South Dakota	322,516	92,179
Tennessee	406	81,263
Texas	334	864,061
Utah	189,746	18,658,597
Vermont	.....	1,588
Washington	20,032	160,561
Wyoming	58	5
Philippine Islands	77,705	40,836
Total production	2,178,197	58,646,622
Total value	$45,027,300	(*a*) $33,252,635

(*a*) Value at 56.7c. per ounce, the average New York price of bar silver.

In comparison with 1926 the output of gold and silver decreased, gold production declining $3,242,300 in value, and silver by 4,072,124 oz.

creased operating efficiency, combined with notable metallurgical progress and rigid economy, maintained 1927 production well up to the figures attained during 1926, as shown by the following table:

	1926	1927a
Gold, value	$3,665,240	$3,500,000
Silver, ounces	19,358,581	19,500,000
Lead, pounds	295,270,025	300,000,000
Copper, pounds	257,464,482	252,000,000
Zinc, pounds	95,179,380	105,000,000
Total value of metal production	$82,662,884	$74,000,000

a Estimated.

All past production records for the camp of Park City were surpassed during 1927, with a total production of 405,683 tons of ore and concentrates compared with 369,710 tons for 1926. The Park Utah Consolidated Mines Company led Park City shippers with a production of 297,312 tons, a 24 per cent increase; the Silver King Coalition Mines Company was second with 81,484 tons of ore and concentrates; Ontario was third with 25,649 tons, and Park Galena fourth with 1,238 tons.

Tintic mines shipped 7,596 carloads of ore and concentrate during 1927 as compared with 10,014 carloads for the year preceding. Leading shippers were the Tintic Standard, Bingham Mines, Chief Consolidated, Plutus, Mammoth, and North Lily. North Lily and Eureka Lily, both non-shippers during 1926, produced 317 carloads and 109 carloads, respectively. The decrease in shipments came as a result of voluntary reductions in view of lower metal prices.

Production at Bingham decreased slightly as a result of the Utah Copper Company's curtailment. Utah Delaware output increased. Ohio Copper and the United States Mine output remained about constant. The Park-Bingham Mining Company made a substantial increase.

Washington—The value of the gold, silver, copper, lead, and zinc produced from the ore mined in the State of Washington in 1927 was about $872,200 compared with $931,491 in 1926, according to the U. S. Bureau of Mines. There was a marked increase in the quantity of gold and a slight increase in copper and zinc. These increases, however, were exceeded by the decrease in the output of lead and the general decrease in the metal prices of silver, copper, lead and zinc. The largest metal mine in the state, the Sunset, at Index, produced approximately 1,500,000 lb. of copper.

The estimated metal production of the state for 1927 follows:

Gold, ounces	12,000
Silver, ounces	90,000
Copper, pounds	1,600,000
Lead, pounds	2,200,000
Zinc, pounds	1,800,000

Production of zinc will probably show a greater increase in 1928, owing to the operation of the new electrolytic zinc plant of the Sullivan Mining Company at Kellogg, Idaho.

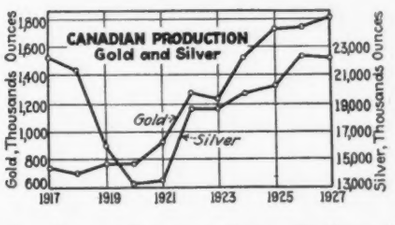
Wisconsin—Shipments from the Platteville district of Wisconsin in 1927 totaled 64,497 tons of zinc blende and 2,085 tons of galena, compared with 57,998 tons of zinc blende and 1,911 tons of galena in 1926.

Wyoming—Estimates of the 1927 iron-ore production from the Colorado Fuel & Iron Company's mine at Sunrise place the output at approximately 600,000 tons, compared with 548,377 tons in 1926. Considerable development of Wyoming's non-metallic mineral resources took place during the year.

Canada

By A. B. Parsons
Associate Editor

WAYS of measuring the status of the mining industry in any country are numerous. Among the indexes are (a) dividends, (b) operating earnings, (c) value of metals and minerals produced, (d) quantity of metals and minerals produced, (e) new capital spent in developing and equipping mining properties—either new or old, and (f) discoveries of new ore deposits and the degree of activity in general exploration and prospecting. If there is any place in the world where it can be said that mining is "booming," as indicated by the amount of white paper that is covered with printed news of activity, and the consequent interest taken by the public—18,000,000 shares of mining stock changed hands in eastern Canada in one recent week—Canada is that place.



Prophets have come forward with predictions that by 1930 Canada will have passed the United States as a gold producer; and they may be quite right. Others have set periods of ten or twenty years within which Canada will be producing copper and lead at greater rates than the United States; and they probably are wrong. Nevertheless, the future outlook is excellent, and the position at the close of 1927 is stronger than it was at the beginning. Taking up the points enumerated above, I shall attempt to give a rather sketchy picture of the Canadian mining situation as it is today.

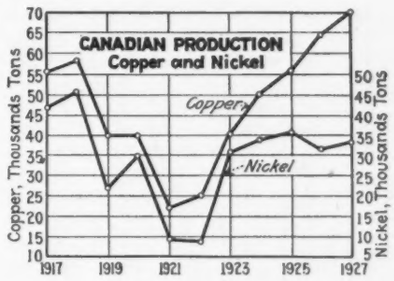
Dividends and Earnings—As a consequence of the lower prevailing prices for lead, zinc, copper, and silver during 1927, operating earnings, even though production costs have been lower in many instances, were smaller than they were in 1926. Somewhat less money probably was spent by dividend-paying companies on capital account. Available data indicate that metal mining companies distributed to their shareholders in 1927 $29,000,000 compared with $27,000,000 in 1926, though this in a measure reflects the earning rate of 1926.

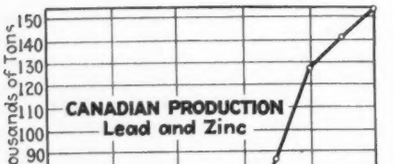
The leading "payers" in order of size were Hollinger, Consolidated M. & S., International Nickel, Howe Sound, Premier, Lake Shore, Wright-Hargreaves, and Dome.

Value of Production—According to the estimates of S. J. Cook, of the Dominion Bureau of Statistics, the gross value of metals produced in 1927 was $112,238,000, compared with $115,237,000 in 1926. The value of gold and nickel produced increased, whereas that of the other metals declined—this, too, owing to the lower prices realized. A slight increase in the value of non-metallic minerals extracted (excluding coal, oil, natural gas, and structural minerals) resulted principally from the greater unit value of asbestos. Asbestos output was worth $10,425,000 and that of all non-metallic minerals totalled $16,874,000.

Quantity of Production—In the accompanying charts the really remarkable expansion in the output of metals from Canadian mines in the last five years is disclosed. Except for silver and nickel, new high records were established during 1927, and even these two metals showed an increase over 1926. There is no reason to doubt that the upward tendency will continue, in view of the new properties that are being developed and the expansion that is taking place at many of the mines that are producing at present.

New Development and Equipment—Probably the outstanding feature of the last year is the progress made in the development and equipment of properties that had not been important producers. In Newfoundland the American Smelting & Refining Company is building a 600-ton concentrator at the Buchans River property, from which, at the start, 18,000 tons of lead per year should be produced. About 3,000,000 tons of ore averaging 7 per cent lead, 16 per cent zinc, and 2 per cent copper has been developed; but it may well be that this is only a small fraction of the ore in the deposit. At Rouyn, Noranda Mines, Ltd., finished the construction of a new copper smelter with a capacity of 1,000 tons per day. Initial production will be at the rate of 3,000,000 lb. of copper per month, though this may be increased. The ore, incidentally, contains $5 to $6 per ton in gold. Development at several other properties in the region of which





Rouyn is the center has progressed during the year.

In Ontario the most important new work has been done in the Sudbury area. The Errington mine is being developed by the Bunker Hill-Treadwell interests, as an immense low-grade enterprise in which zinc, copper, lead, and precious metals will be produced. Little official information is available, but 3,000,000 tons of $22 ore has been proved, a concentrating plant is being built, and systematic development of a huge ore "zone" is under way. At its Frood mine, hitherto an unimportant producer, the International Nickel Company is opening remarkably large deposits of nickel-copper ore. Some of the ore is very rich; some of comparatively low grade. However, the potential supply of nickel is enormous and the copper will by no means be an inconsiderable factor. Estimates in circulation in Ontario place the tonnage of ore reserves in each of these deposits at upward of 100,000,000 tons.

Manitoba is the scene of two major developments: the Flin Flon and the Sherritt Gordon. The Flin Flon orebody has been rather thoroughly drilled, and above the 900-ft. level, a minimum of 18,000,000 tons of ore containing copper, zinc, gold, and silver has been developed. Estimates give an average copper content of 3¼ per cent, and of zinc 8 per cent. Operation of a pilot concentrator during 1927 demonstrated the practicability of making a satisfactory separation of the copper and zinc; and it is said on good authority that at current prices the value of the recoverable metals will be more than $10 per ton. A definite announcement of the immediate construction of an 85-mile railroad to the property has been made. At the Sherritt Gordon much less drilling has been done, but the "possibilities" are that 20,000,000 tons of ore containing 2¼ per cent copper, 5 per cent zinc, and some precious metal content can be mined. In Central Manitoba a mill and cyanide plant for the treatment of gold ores has been erected during the year and other properties are being developed.

Plant expansion by the larger mining companies at producing properties is the most important factor in British Columbia's progress during the year. Consolidated Mining and Smelting continually expands at Kimberley and at Trail; Granby has added to its plants at both Allenby and Anyox; and mill capacity has been increased at Britannia Beach by Howe Sound. Better prices for lead and zinc would stimulate production at small mines in British Columbia.

New Discoveries and Prospecting—Particularly in Eastern and Central Canada—Quebec, Ontario, and Manitoba—the search for new mines is active. Not only are prospectors of the "old-time" type searching for outcrops, but geological reconnoissance surveys are being made, and geophysical methods of finding indications that warrant drilling are in vogue. Hundreds of prospects are the scene of preliminary development work; and on scores of others such work has shown indications at least good enough to justify the continued expenditure of money in the hope of making a mine. Yes, the future of Canada's mining industry seems bright.

Mexico

By W. L. Vail
Special Mexico City Correspondent

THE mining industry in Mexico showed considerable improvement in 1927, political problems becoming of diminished importance toward the close of the year, and unsatisfactory metal prices alone remaining as the chief obstacle to a more general expansion of operations. Opinion among large and small operators seems to concede that the government has, in the majority of instances, met the mine managements half way. Although some objection has been raised against the income tax, which is in addition to the production tax, it is admitted that the government has been notably fair in rebating taxes on low-grade silver and complex ores and has been extremely liberal in extending permits for shutting down, where it has been shown that operations were being conducted at a loss.

According to government statistics the tonnage of ores treated declined 4.05 per cent as compared with 1926. This reduction is attributed to lower metal prices and high government taxation. Low-grade producers furnish the greater part of the total tonnage, and the conditions mentioned resulted in the suspension of a number of such operations. A total of sixteen shutdowns was recorded during the year. The average monthly decrease in ore production due to these closures was, according to official reports, 40,640 tons, representing 4.5 per cent of the total monthly ore output. Aside from the plants of the American Smelting & Refining Company, at Velardeña, and those of the International Mining Company, Consolidacion Minera de Parral, and the Beneficiadora del Norte, however, the properties affected were of minor importance. The general mining situation of the republic, judged by the following comparative statement of production, covering 1926 and 1927, is indeed favorable:

	1927 (a) Kilos	1926 Kilos
Gold	22,000	24,033
Silver	3,110,000	3,057,268
Copper	56,474,000	53,763,192
Lead	238,503,000	210,794,394
Zinc	130,634,000	105,336,568
Antimony	1,707,000	2,614,444
Arsenic	8,205,000	6,458,224
Graphite	6,510,000	4,434,548
Mercury	78,000	45,416

(a) Production for last two months estimated.

The above figures show that in 1927 there was a decrease of 8.46 per cent in gold production compared with 1926, and a decrease of 34.70 per cent in the output of antimony. All the other minerals showed an increase for the year: silver, 1.07 per cent; lead, 13.14 per cent; copper, 5.04 per cent; zinc, 24.01 per cent; arsenic, 27.04 per cent; graphite, 46.80 per cent; and mercury, 71.74 per cent. Practical exhaustion of the gold ores in El Oro and Tlapujahua has been considerably compensated for by an increased production from silver ores in the larger camps. Increase in silver production was due to more intense exploitation of the old camps, and selective flotation treatment of complex sulphides of silver, zinc, and copper. The gains of lead and zinc resulted from the introduction of modern ore-treatment equipment and the general adoption of selective flotation, permitting the exploitation of ores hitherto unprofitable. The slight increase in copper output may be accounted for by the fact that, although the average price of copper was only about 13c. per pound, improved facilities for production at Cananea and at the Moctezuma Copper Company's plants considerably reduced former production costs and permitted operations to be maintained at these properties throughout the year. The importance of the introduction of selective flotation into Mexico may be appreciated from the fact that during the year 30 per cent of the actual ore tonnage was treated by this process. A notable increase of over 71 per cent in output of mercury produced is to be credited to the high prices prevailing, which have led to the opening up of a number of hitherto idle properties in the State of Guerrero.

During the year, 1,740 solicitudes for mining concessions were recorded, or an average of 145 monthly, as against a monthly average of 188 for the five preceding years. The slight falling off, according to the government, is due to the fact that, under the new mining laws, holders of concessions are required to do a minimum amount of work on their properties in order to retain them.

Labor conditions, in general, were pronounced considerably improved during the year, and satisfactory. There were some few isolated spots of contention. Wages increased and the output per worker showed an improvement. Strikes were fewer than during the

previous year, and the organization of the federal labor board is considered an excellent measure for regulating differences between employers and employees. In the absence of specific legislation, the board still respects state regulations regarding payments of indemnities, but regulatory measures concerning such payments are now pending before the Mexican Congress. The total decrease during the first ten months of 1927 in the number of workers at metallurgical plants and at the mines was about 4,500. Many of these, however, were re-employed elsewhere. This policy of reducing operating forces continues. The following numbers of workmen were reported as being employed on Dec. 15 at the properties mentioned: Pachuca, 13,000; Cananea, 1,500; Boleo, 2,547; Teziutlan, 500; Fresnillo, 2,100; Pittsburgh Vetagrande, Zacatecas, 800; Cinco Minas, 850; Amparo group, Jalisco, 1,400; Guanajuato, 1,000; Santa Eulalia, 1,275. The American Smelting & Refining Company employed on that date about 14,000 men and the Peñoles company about 7,500.

A brief review of the mining industry at the close of 1927 in the various states of the republic, follows.

Chihuahua—The flotation mills of the American Smelting & Refining Company were operated throughout the year at capacity. Recession in zinc and lead prices seriously affected profits all over the state. The San Francisco del Oro Mining Company relinquished several options and leases, and suspended operations at Clarines. El Potosí Mining Company's flotation mills operated regularly, but no new plants were erected. Ahumada and Erupcion operated on a somewhat curtailed basis. The Real del Monte did considerable exploration work in the district of Las Damas, where encouraging lead findings were reported. At the property of the Cusi-Mexicana Mining Company, adjoining the old Potter Palmer properties, developments indicate that it should become one of the large producers. The milling plant for the production of zinc concentrates should be in operation by next July. The Peñoles interests operated their San Pedro property in Corralitos; numerous new workings are reported in Casas Grande, Santa Eulalia, Hidalgo de Parral, and the Juarez district.

Durango—The Trovador mine has been opened in the Velardeña district. Operations have also been started at the Guadalupe and Terrible property, in the Inde district, where a flotation plant has been completed. In the Parrilla district, the San Nicolas Mining & Milling Company is erecting a flotation plant and preparing to ship concentrates. The Peñoles company is also completing its plant at Mapimi for the treatment of sulphide ores from their Ojuela Unit.

Guerrero—The Compañia Minera Real del Tasco has begun working the Juliantla mine and is treating its own ores. The Chontalpan Company has begun the construction of a 150-ton flotation plant for treating ores from Xitinga and Montecarlo. By the middle of January, the Peñoles company expects to have its plant at Achotla in operation.

Prevailing high prices of mercury have caused considerable activity in the various mercury districts near Iguala; small operators, particularly those in the Huahuaxrla district, are reported doing well and installing furnaces of modern type. The General Development Company has discontinued operations at Campo Morado, owing principally to the prohibitive cost of transportation. The American Smelting & Refining Company and the Peñoles company are reported to be examining various properties in the Zacualapan and Taxco districts. Extension of a power line from the Toluca Power Company into these districts has done much to stimulate mining.

Jalisco—The Tiger Mining Company, of Sonora, has taken over, on a rental basis, the properties of El Favor Mining Company, and is making a study of methods for treating the ores. A new property, rich in zinc carbonates, has been opened at Cihuatlan by Alfredo Fernandez Castello. Work is normal in the Amparo district and at Cinco Minas.

Mexico—Closing of the El Oro Mining and Railway Company and the Esperanza mine in El Oro was a serious blow to the gold-mining interests. The Rincon mining interests at Temascaltepec operated their 150-ton cyanide plant, and, as yet, have not reached the lowest level of the property. San Juan Bautista Mining Company, Sultepec, has installed a 30-ton cyanide plant, and the San Antonio y Anexas and Beneficiadora de Veta Madre companies have also completed flotation installations. In Zimapam, the Fulton Mining Company and Trinidad Mining Company have completed and placed in operation small milling units for handling their own ores.

Michoacan—The Mirador del Oro Mining Company is operating in the district of Arteaga, treating its own ores. The Carmen del Virgenes Company, of Tlalpujahua, is working steadily, sending its ores to the Molino de El Cedro, of the Dos Estrellas company. Operations of the mill at Dos Estrellas and of the American Smelting & Refining Company at Angangueo continued during the year at a normal rate.

Morelos—In Tlaquiltenango, the Santiago Mining Company carried on extensive exploration work and began the construction of a milling plant.

Oaxaca—The Gerard-Daly interests, in the Taviche district, have returned the San Jose property to the owners. Several properties examined by the Peñoles company and other large interests were not taken up. The American Smelting & Refining Company continued to develop and equip the San Juan mine. The Peñoles company closed its mill at Natividad and restricted operations there to development work. A general curtailment by small operators throughout the state has been noted.

Puebla—The Mexican Corporation is reported to be successfully operating its flotation plant at Teziutlan. Early in the year considerable exploration work was in progress in various parts of the state.

Sinaloa—Compañia Mexicana de Minerales has obtained a federal concession to erect a lead smelter of 400 tons' capacity near the port of Mazatlan.

Nayarit—Development has been curtailed in numerous sections of the state because of lack of security. Several properties have been under examination by large mining interests.

Aguascalientes—The Minerva Mining Company started its mill and Diesel plant. During the first part of the year, the San Geronimo copper mine, in the Asientos district, shipped a considerable tonnage of high-grade copper ore; shipments recently have been curtailed.

Tamaulipas—Minera El Rey is working the Manuel Maria mine at Victoria.

Zacatecas—Closing of the lead properties of the International Mining Company at Guanajuatillo seriously affected operations of the small smelter which Peñoles was operating at Guadalupe. The Sombrerete mines, operated by the American Smelting & Refining Company, were also closed. Mazapil Copper Company has completed a 250-ton selective flotation plant for the treatment of sulphide zinc and lead ores from the company's properties at Mazapil and Concepcion del Oro. Peñoles has completed its 175-ton lead smelter at La Fé. The International Mining Company has installed a flotation plant for treating ores from the Bilbao mine. Most of the properties operating in the state were affected by the prices of zinc and lead. La Noria mine, operated under contract by the El Oro Mining & Reduction Company, worked at full capacity on high-grade silver ore.

Queretaro—The Braniff estate is reported to be again operating the Doctor properties in the Cadereyta district. Several antimony prospects have been opened up near Pinal de Amoles.

South America

By Lester W. Strauss
Mining Engineer, New York City

During 1927 South America increased its output of petroleum and copper. A revival occurred in the nitrate market, and heavy shipments resulted; a higher silver production was reported, principally as a byproduct of copper. More vanadium and platinum were produced. Interesting developments are foreshadowed in tin production. Unfortunately, taxation programs that have recently become effective and are con-

templated have dampened enthusiasm in the investment of new capital in mining propositions. Iron-ore shipments remained at the same level as in 1926, whereas lead and antimony exports were lower. Information in regard to gold gives one the impression that the previous year's production was exceeded.

Chile continued to be the outstanding mineral producer of South America. The features of 1927 included the "comeback" in nitrate prices, copper activities, and taxes proposed on imported fuel.

At the beginning of 1927 the outlook for the sale of nitrate was discouraging, and production fell far below normal. With the initiation of free sales, shipments began July 1, and prices rose from 15s. per 100 kilos in May, to 18s. 3d. in November. The stocks of nitrate were disposed of, so that by March 15, 1928, it is anticipated that none will exist. Production rose from 70,000 tons per month in February to more than 200,000 tons in November. The Guggenheim process of the Anglo-Chilean Consolidated Nitrate Corporation at the Maria Elena oficina began to operate in November, 1926, and had reached a productive rate of 21,000 tons of 98 per cent nitrate in November, 1927. Cold-leaching tests were carried on elsewhere by other companies, but results have not been made public. Other "heralded" processes are still much in the experimental stage, though some succumbed because of impracticability. The du Pont Nitrate Company closed down its Peña Grande plant, thereby leaving the field after many years' operations. Production of nitrate for 1927, despite the shutdowns of many plants, was forecast as 1,600,000 tons. Exportation was at a higher rate, accounting for the liquidation of stocks.

With the successful completion of improvements that represent an investment of $17,000,000, the Chile Copper Company is now sufficiently equipped to produce at the rate of 375,000,000 lb. of copper per annum. The campaign of extension in output has not materialized, and output in 1927 will prove to be about 110,000 tons. During the first nine months of 1927, 6,024,000 tons of ore was treated, of an average copper content of 1.6 per cent, from which 165,500,000 lb. of copper was produced. The ore reserves remain almost unchanged, as new developments added reserves equal to ore mined. Two features of operations are of particular interest: one complete 75-liter per hour liquid-oxygen unit has been producing for a year, with highly satisfactory results; and in the mining department the lower bench lines have been electrified, thereby effecting a reduction in haulage costs. Eight additional 75-ton locomotives are to be installed. These and other improvements indicate that an aggressive and well-organized operative campaign is the outstanding characteristic of the Chile Copper Company's efforts.

As a result of the intensive effort and the excellent organization of the Andes Copper Mining Company, the flotation unit, with a capacity of 12,500 tons of ore per day, and the complementary smelter, consisting of roasters, reverberatories, and converters, at Potrerillos, were erected by December, 1926, and copper was poured in January, 1927, less than two years from the beginning of construction work—a notable achievement. The leaching plant for oxide ores is expected to be ready early in 1928. The mine has been well prepared to furnish the tonnage required, the system being an adaptation of the Inspiration method. Present monthly operations are at the rate of about 2,500 tons of copper per month, resulting from the monthly treatment of about 200,000 tons of ore. The 30,000-kilowatt steam plant, oil fired, on the coast at Barquito—about 90 miles westward from the mine—has been operated successfully.

A low-grade copper deposit, which had been developed since early in 1925 by American capital in the Las Condes district, to the east of Santiago, stopped work in May. Another low-grade copper property was being developed on behalf of New York capitalists at Sagasca, inland from the port of Iquique. Work was discontinued early in 1927.

The premier copper mine of the world in the early 'fifties was the Tamaya property, about 50 miles south of Coquimbo. Its total production, principally as copper bars, is about 300,000 tons, most of which resulted from the treatment of the mineral in the old Welsh type of reverberatory furnace at the port of Tongoy. The American Smelting & Refining Company, during 1927, took a long-term option on the main properties. A crosscut tunnel is being continued. It is estimated that the main vein will be cut at 2,700 meters from the portal, at a depth of 600 meters below the outcrop. At the end of 1927, about 1,340 meters had been driven, with approximately 1,360 meters lacking to reach the vein. Tamaya has been unproductive and inactive since the late 'eighties.

The principal vein copper properties maintained production in 1927, the most important being the Cia. Minera Tocopilla, at the port of Tocopilla, and the Cia. Minera Disputada, in the Las Condes district; both have flotation mills; the former also produces shipping ore. The Catemou and Naltagua companies, in central Chile, between Valparaiso and Santiago, are the only copper-bar producers; the Gatico mine, south of Tocopilla, produces shipping ore and flotation concentrates; and the Poderosa property, at Collahuasi, near the Bolivian border, produces shipping ore. Smaller properties near Santiago and in the vicinity of Copiapó, further north, contribute small amounts of shipping ore. The total 1927 copper output in the form of ore and concentrates may be 14,000 tons, which, added to the copper bars produced, makes a total of approximately 20,000 tons. Chile's copper production for 1927 was about 260,000 tons.

The coal industry of Chile passed through a trying crisis early in the year, until the nitrate industry revived. The year's output was about 1,500,000 tons—insufficient to meet the normal requirements of the various industries. Efforts have been made to foster the industry at the expense of the more important nitrate and copper industries, whose combined yearly operating outlays mean far more to the Chilean government than that of the coal companies; but the discrimination was appreciated in time by President Ibañez.

The Bethlehem-Chile Iron Mines Company shipped in 1927 about 1,400,000 tons of ore from its property at Tofo, north of Coquimbo. The export tax has been increased to 25c. U. S. currency per ton of ore, said to be a protective measure in view of the proposed attempt to smelt electrically at Corral, in the southern part of Chile.

The Borax Consolidated Company's property, at Cebollar, in northern Chile, was in continuous operation, but information is withheld as to details of production and technology. The mineral is a species of colemanite. Chile's sulphur output has decreased, due to drop in price in that country, as well as declining consumption. The two important producers are at Tacora, inland from the port of Arica; and at Ollagüe, close to the Bolivian border. Gold mining and washing did not meet with the anticipated results. No silver mining was carried on; nor was any lead mine of importance opened up.

During 1927 a complete set of new laws was formulated in regard to oil lands, so that capital would not be hampered if it should decide to investigate petroleum possibilities. An American syndicate is interested in the oil shales near Lonquimay, 600 miles south of Santiago. To date no development work has been done, and further steps depend, in part, upon the action of the government in regard to the proposed railroad to the Argentine border, which must pass through the property.

In Peru, the features of mining progress in 1927 were the increased copper and silver productions, development of silver-lead-zinc and silver-lead mines, increased petroleum and vanadium outputs, and the furthering of plant installation in regard to the production of lead bullion and probably electrolytic zinc.

During 1927 the Northern Peru Mining & Smelting Company, a subsidiary of the American Smelting & Refining Company, continued the development and operation of its properties in the Department of Libertad. Ores from the Diana mines, in the Salpo district, were sent to be milled at Samne, the gold-silver concentrate being shipped to Selby, Calif. Early in 1927 the Quiruvilca property was put on a productive basis, the ore (copper-silver) being sent by rope tram to the mill and smelter at Shorey, where it was screened without crushing. The undersize from the $\frac{3}{4}$-in. screens goes to the mill and the oversize

to the smelter. The copper-silver concentrate, after being briquetted with fluedust—with gypsum as a binder—is then smelted. The company controls the Callacuyan coal mines near Quiruvilca. The siliceous flux, carrying silver and gold, comes by rope tram from the Salpo district. Production was also continued, in a small way, at the Potaz gold mine. Development of the Chilete silver-lead-zinc property, 60 miles from the port of Pacasmayo, was active throughout 1927, but no decision has been reached regarding the equipment of the property for production.

The operating results of the Cerro de Pasco Copper Corporation during 1927 were on a par with those of the previous year in regard to copper output—45,000 tons. A lower production of silver, 12,000,000 oz., was due in part to an accumulation of lead concentrate. The concentrate will be smelted at Oroya, where one of the copper blast furnaces has been replaced by a lead stack with a daily capacity of 300 tons of lead concentrates, ores, and fluxes; it was anticipated that the stack would be blown in in December, 1927. A Betts process refinery may be added later for the refining of the lead and the recovery of the bismuth. Zinc concentrate continued to be shipped to Antwerp, but investigation is under way as to the practicability of erecting a 20,000-hp. hydro-electric plant, which is to furnish power for a proposed 100-ton electrolytic zinc plant. The experimental work on the low-grade silver ores, which has been carried on for some years, is progressing favorably in the 50-ton pilot mill. It is hoped that some decision may be reached during 1928 in regard to large-scale operations.

A monthly output of 30 tons of copper matte was effected by the lessee of the Sayapullo property, north of Trujillo. The Sacracancha lead-silver-zinc property, near Morococha, is now equipped with a 130-ton flotation mill. Its products are to be sold to the Cerro de Pasco company. At Ticlio the Volcan mine has been taken over by New York interests, development work through tunnels having disclosed a long shoot of good-grade silver-lead-zinc-copper ore. The same interests are developing the Santander mine, 35 miles from Casapalca. An irregular ore zone of great width in limestone has been disclosed, with high-grade silver and zinc content and a fair percentage of lead and copper.

The production of the Vanadium Corporation of America at Mina Ragra, near Cerro de Pasco, in 1927 was 6,700 tons of 18 per cent V_2O_5, which was exported to the corporation's plant at Bridgeville, Pa. The improvement program, started about three years ago, with the replacement of llama haul of ore by railway transportation, was carried further during 1927 by the completion of the hydro-electric power plant at Jumasha, five miles below the mine. The erection of a concentrating plant is under consideration.

Gold-mining operations in Peru are not extensive, though concessions covering alluvial deposits continue to be presented to foreign capital. The silver mines at Cayollma were productive. The property is said to have been optioned to Chilean capital.

In Bolivia a diminished activity in tin was expected during 1927, due to an anticipated production which did not materialize. No new outputs occurred, though several placer properties were under examination, and American capital investigated several promising vein possibilities.

The most important mining features were the operating results of the tin dredge near Potosí; the promising expectations for the Matilda zinc property, near Lake Titicaca; and the return of the Huanchaca mine as a silver producer. Lead, antimony, and copper exports declined; prospecting of petroleum ground continued.

Operations of the Patiño Mines & Enterprises Company for the first nine months of 1927 resulted in an output close to 8,300 tons of fine tin, the third quarter showing marked improvement over the first half of the year. The production of the Caracoles Tin Mining Company, controlled by the Guggenheims, was higher than in 1926, as a result of the output of the dredge at Aroifilla, close to Potosí, which began digging in September of that year. The monthly average during 1927 was 150 tons of black tin. Combined with the concentrate resulting from the operation of the Caracoles mine and mill, the yearly productive rate was from 6,000 to 7,000 tons—about 4,000 tons of fine tin in the form of concentrate.

About 15 other tin-producing companies, with few exceptions all Chilean, are responsible for the remaining half of the tin production, which was close to 35,000 tons for 1927. During the second half of the year the silver output rate was higher, owing to the activities at the Huanchaca mine, near Uyuni, now under the administration of M. Hochschild & Company. The dump is being treated in a M.S. pilot mill, the results thus far being satisfactory. Zinc-silver and lead-silver concentrates are to be the products. Unwatering of the lowest levels of the mine has been accomplished and silver ore encountered. The Matilda property, which was acquired by M. Hochschild & Company in 1926 and subsequently extensively developed, is said to have a large tonnage of commercial zinc ore; the vein was originally opened up for lead possibilities and produced a limited tonnage. A small pilot plant has recently been erected for experimental purposes; meanwhile, no production is contemplated. Bolivia's lead output has declined because of reduced exportation of slags. Some lead developments were discontinued, but in the region of Tupiza it was reported that several small producers were active.

Production of antimony was curtailed because of price drop. Corocoro continued to be the copper camp of Bolivia, which distinction it has carried since 1870, though operations are said to have been commercially unsatisfactory. Only the Corocoro United Copper mine was active, as the Cia. Corocoro de Bolivia was pumping the lowest levels and handling the water. Drilling for petroleum was active. An interesting achievement, which may have an important bearing on the future mineral resources of Bolivia, was the opening of railroad traffic between Tupiza (Bolivia) and La Quiaca (Argentine). Now it is possible to ride from La Paz to Buenos Aires, via Uyuni, with only one change of cars, necessary by reason of variable gage of track, in a schedule time of 70 hours. Freight expansion from Tupiza and southward to Santa Fé, an Argentine tidewater port, may result unless favorable rates are made via Uyuni to the port of Antofagasta, Chile.

In Colombia an improved output of crude platinum for 1927 of about 45,000 oz. was reported, but the outstanding feature was the increase in petroleum output, which amounted to 15,000,000 bbl., compared with 6,440,000 in 1926. Unfortunately, a tendency is to be noted to pass unwise and unfair petroleum laws, some of which extort from owners of private lands, or their lessees the oil companies, an additional 10 to 20 per cent royalty; this policy will destroy credit and serve notice that foreign capital is not wanted.

The largest individual platinum producer is the South American Gold & Platinum Company. At present it has three dredges in operation, which were responsible for about 20,000 oz. of crude platinum and 6,600 oz. of gold in 1927. The dredges are electrically driven. The company has been successfully operating a hydro-electric plant about 30 miles from the boats. It was stated that the British Platinum & Gold Corporation discontinued operations because of the exhaustion of the grounds. Considerable crude platinum is also produced from hand washing operations. It is of passing interest to mention that the price of the metal has dropped from $110 to $64 per ounce, which may be a Russian move to discourage South African operators. Recent advices state that copper prospects have been encountered in the vicinity of Bogotá. No data on emerald production are available; the output is controlled by the government. An anticipated gold output has not as yet materialized.

In the Argentine, the outstanding phase of metal mining has been the production of lead. The National Lead Company was probably the most important producer, following developments at the property close to Pumahuasi, in northern Argentina, and the smelting operations at the plant near Buenos Aires, about 1,600 miles to the south. Monthly output was 250 tons of pig lead. Close to Salta, in northern Argentina, a Spanish company controls the Mojotoro smelter, whose principal source of lead minerals is

in the district in which the National Lead Company is also operating. The monthly output may total 250 tons of pig lead. Near San Rafael, in the State of Mendoza, the Minera Las Picaza completed a 100-ton water-concentration mill, and production was started. Unfortunately, the mine had not been developed to keep pace with mill requirements. The Capellitas mine, in the State of Cajamarca, was to be reopened to develop copper-zinc ore. The once-famous Famatina copper property was again shut down after efforts to re-establish smelting operations. According to government engineers' reports the property had not been sufficiently developed. The petroleum output probably reached 7,500,000 bbl. in 1927. A bill to nationalize new oil lands was before Congress, but it is believed that it will not be passed.

In Brazil an interesting development has been undertaken by the Bahia Corporation, of New York, to bring the property on the Paraguassu River, 250 miles west of Bahia, to a productive stage in the output of carbons and white diamonds. The placer machinery being installed is the first of its kind adapted thus, and operations are expected to start in October, 1928. The capacity of the plant is 300 yd. per day. Data on gold-mining activities are meager. It is stated that the average gold content of ore in the Ouro Preto and St. John del Rey mines is declining at depth. The country's manganese output was considerably less than in 1926, said to be due in part to overpurchase during that year. A start has been made to utilize iron ore in the country. The lack of coal, but abundance of water power and fluxing material, make smelting at the mines a complex problem, aggravated by the temperament of local capitalists and the jealousy of the several states, which connotes lack of co-operation and hampers progress.

In Ecuador, gold and oil are the only mineral exportations. Output for 1927 was estimated at 5,500,000 bbl. of oil. The gold-silver mines of the Zaruma district, operated by the South American Development Company, continue to be the only properties of importance. The 1926 production was 62,000 oz. gold and 92,000 oz. silver. The first ten months of 1927 indicated results within 5 per cent of this. A small amount of the country's gold production results from hand washing operations practiced by the Indians.

In Venezuela, the outstanding development in 1927 was in the petroleum output, more especially in the Lagunillas field. At the present rate, Venezuela stands second to the United States in production, with a probable total of 55,000,000 bbl. for 1927. During the month of October 6,000,000 bbl. was shipped. Gold is being exploited in veins and in dredging ground. Copper production data from the operations of the South American Copper Syndicate are not available.

Central America

By Charles Butters
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LITTLE mining activity was reported in the Central American states during 1927. In Guatemala, what had promised to develop into a boom because of the high price of lead and zinc did not materialize, owing to the drop in price of these metals. In Salvador, International Railways is opening up a new mineral district on its road from Santa Ana to Zacapa. Copper has been found, but in veins of no commercial value; also some mixed sulphides of zinc and iron in fairly large veins. Gold and silver mines in the San Miguel district are closed down, including San Sebastian, Divisadero, Encuentros, and Comacaran. Gus A. Swanquist, at the Monte Cristo gold mine, on the Loma Larga estate, has 10,000 tons of commercial ore developed. San Sebastian, with a record of $16,000,000 in gold produced in about twenty years, is believed capable of developing new orebodies in its western extension, as well as in depth; but, as the company is in liquidation, additional financing is needed to reopen it.

Honduras has, apart from the New York, Honduras & Rosario Mining Company, only a few small properties in operation. The country has not lived up to its reputation in recent years. Major Burke has restarted operations in the Yuscaran district, and hopes to develop large orebodies. The New York, Honduras & Rosario is producing regularly, but at a somewhat lower rate than usual; however, output is returning to normal.

Nicaragua has been in trouble, which has made difficulties for the mining companies. A revolution began in October, 1925, and continued until Mr. Stimson, acting for President Coolidge, made a peace settlement with General Moncada in the spring of 1927; but General Sandino, from the State of Nueva Segonia, refused to accept the settlement. He took the field as a bandit, and on June 19, 1927, seized the San Albino mine, a property under my control, and issued a decree declaring it forfeited and expelling all Americans there.

He held and worked the property until Aug. 1, 1927, when Major Floyd, of the U. S. Marines, arrived with his forces. Sandino then evacuated the place, after taking the dynamite, caps and fuse, the stores, mercury, carbide, miners' lamps, the commissary—in fact leaving nothing that could be moved. Major Floyd left after destroying, for military reasons, 30,000 ft. of fuse, blasting caps and dynamite, which had been placed by Sandino to destroy the property before leaving.

The American marines landed were supposed, among other things, to protect American lives and property in Nicaragua; but as far as San Albino is concerned I was unable to get permanent protection. With 2,500 marines in the country, I pleaded for a small permanent guard to allow safe occupancy and operation of the mine. This was not done, because of the small number of men detached for the northern section and consequent inability to quiet the section by capturing the leaders. The result is that San Albino is almost abandoned; and, until the bandits are captured, the mines, on which $700,000 has been expended, are merely the crossroads for roving bands of robbers.

In Costa Rica, the Sacra Familia and the Abangares are in operation. William Hanna, former manager of the Sacra Familia, is now in Nicaragua.

Cuba

By J. C. Porter
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THE Matahambre mine, of Pinar del Rio, continues to be the only steady copper shipper in Cuba. During 1927 development work was kept well ahead of mining, so that an adequate ore reserve has been maintained. Improvements to plant and camp have continued, and this property is today in condition to do efficient mining and to provide for the health and the comfort of its employees.

The Mining Department of the Cuban government has furnished the following figures of shipments from July 1, 1926, to June 30, 1927. During this period 240,936 metric tons of ore averaging over 4 per cent copper was mined. The best of this was hand sorted to yield an 18 per cent product and shipped. The rest was passed through the concentrator. Ore and concentrates shipped during the above period amounted to 54,777 metric tons, all going to the United States.

The Matahambre mines began operations in 1913 under the direction of the owners, the M. L. Diaz family, of Havana. Later, this property was acquired by the American Metal Company, which made many improvements and changes that have reduced costs to a satisfactory figure. In the fourteen years of activity of this property, 651,426 metric tons of ore has been shipped to the United States.

The Bethlehem-Cuba Iron Mines Company during the year July, 1926, to June, 1927, shipped 490,654 metric tons of hematite ore from Daiquirí, on the south Oriente coast, to Baltimore. From Mayarí, on the north coast of Oriente, this company shipped during the same period 16,896 metric tons of "soft" ore to Baltimore.

The Bethlehem-Cuba Iron Mines Company also shipped during the same period, 14,730 metric tons of chrome ore averaging about 43 per cent Cr_2O_3. This was gathered from several small deposits in Oriente Province. About 2,400 tons was shipped from Mayarí. The only reg-

ular shipments of manganese ore were from La Gloria property, near San Luis, in Oriente Province. About 2,400 tons was shipped during 1927. This, as well as a few minor shipments, went to the United States.

South Africa

By Owen Letcher
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THE outstanding events in the mineral industry of South Africa during 1927 comprised (a) the maintenance of productive operations by gold mines of the Rand, and preparations for expansion in the southeastern sector of this field; (b) further increase in diamond output from alluvial sources, which will render the 1927 production a record; and (c) further expansion in base-metal mining activities, particularly in Northern Rhodesia.

A continuation of platinum mining and of developments in connection with platinum metallurgy has been recorded. Increase of asbestos production in the Union, as well as in Southern Rhodesia, is to be noted. In South West Africa, exploitation of mineralized areas has occurred, particularly in respect to tin.

Completion of new furnaces by the Union Minière du Haut-Katanga foreshadows an early expansion of copper output by that company. The approaching completion of the Bas Congo and Lobito Bay railway projects will have an important influence on mining industry generally in South Central Africa.

The Witwatersrand is and may be expected to remain for many years to come the leading center of industry. For the first seven months of 1927 the value of the gold output has averaged £3,435,000 per month. At this rate of output the value of the Witwatersrand's 1927 production may be estimated at £41,200,000 compared with £41,062,000 in 1926 and £39,702,245 in 1925.

A determining factor in the volume of gold produced by the mines of the Rand is adequacy of native labor. At times during the year this has fallen considerably short of requirements, and some anxiety recently has been occasioned by the threat from Portuguese East Africa of restricting supplies. In the interests not only of the gold mines and the collieries, but of commerce and industry generally, it is hoped that the Union and Portuguese East African authorities will be able to formulate a new agreement insuring amicable and satisfactory relations between the two countries.

The adoption of narrower stoping and more selective mining has been the feature of underground practice. Another feature on the East Rand is the extended use of concrete pillars and disks for the support of the hanging wall. In regard to metallurgy, few developments of novelty or significance have occurred.

Working costs at the mines have been maintained at about 19s. 5d. per ton throughout the year—a satisfactory figure when it is remembered that the Rand gold field is being exhausted at the rate of about 34,300,000 *mining* tons per annum, and that each year not only is the average stoping depth increased but workings are at increasing distances from the main shafts and haulageways.

The Central Rand has for some time been the deepest mining field in the world, and in 1927 a vertical depth from surface of 7,650 ft. was reached in the Village Deep mine—the greatest depth to which man has penetrated in his search for mineral wealth. Depths of 6,000 ft. and over have also been reached, or fall within the scope of operations in the near future, in the City Deep (where the largest electric hoist in the world recently was installed); also at the Crown mines and East Rand Proprietary mines. The absorption of the Cinderella Consolidated by the latter was one of the important events of the year. The Far East Rand has continued to be the most productive and profitable portion of the field. Government Areas, with an annual production of about four and a third million pounds sterling, has held its own as the most productive gold mine in the world.

The New Modderfontein has increased profits, and the 10s. shares have risen until they have touched £6 10s. The Geduld East mine, floated at the beginning of 1927, continued successfully mining through the Geduld Proprietary. Reconstruction and enlargement of the Daggafontein will enable that area to be opened up through the Springs mine.

In the southeastern sector, the Sub Nigel continues to report satisfactory development and productive results, and an enlargement of its plant has been agreed upon. On the West Rand the principal event has been the erection of new plant at the West Rand Consolidated. When this is in operation the company will be able to crush 1,000,000 to 1,200,000 tons per annum.

Tenders for new lease areas in the vicinity of the Rand Collieries and Luipaardsvlei mines have been requested by the government, and it is probable that exploration will be undertaken at an early date.

The year 1927, like 1926, proved eventful for the diamond trade of South Africa. It witnessed a further expansion of alluvial diamond-winning activities in the Lichtenburg fields of the Western Transvaal, constituting a further serious threat to the stability of the diamond market and to the ability of the big purchasing syndicates to absorb production. The production and sales of diamonds in the Union of South Africa from January to August, 1927, inclusive was 2,808,165 carats, of a value of £8,561,014. With the object of placing the diamond industry on a more stable footing, the government introduced the Precious Stones Amending and Consolidating Bill, but this was rejected by the Senate and is now being reconsidered at a special session. In the early part of 1927 the greatest "rush" ever witnessed in South Africa took place upon the proclamation of the farm Grasfontein. A further proclamation which attracted a large number of "diggers" was that of the farm Welverdiend.

Sensational discoveries of diamonds were made at Alexander Bay, a few miles to the south of the mouth of the Orange River. A parcel of about 12,000 carats, valued at approximately £150,000, was recovered in a few weeks.

The Union's coal outputs have been maintained at over one million tons per month, and nearly one thousand ounces per month of platinum is being produced. The total value of the Union's mineral production for 1927 is expected to be over £60,000,000.

In Southern Rhodesia the value of the mineral output for the first seven months of 1927 was £2,562,710. The gold output is at the rate of approximately 50,000 oz. per month. Attention is being directed to the Southern Rhodesian Base Metals Corporation, owning several copper, zinc, and lead properties in the valley of the Sanyati River. A pilot plant has recently been started at one of these properties, the Copper Queen. A railroad from Sinoia to the mines may be constructed in 1928, and it is also rumored that the Maroba coal field, near the properties, may be opened up.

Chrome production has increased greatly, and it is believed that if a reduction in railway rates to Beira could be secured, a further large expansion of this branch of the mineral industry would result in both the Selukwe and Umvukwe districts. Southern Rhodesia has fully maintained its position as the second asbestos producing country in the world. The Shabanie mine has been equipped with new plant. Important discoveries have been made in the Lomagundi area.

In Northern Rhodesia, the various concessionary companies have continued exploration. Airplanes, electrical prospecting, and other modern methods have been employed to accelerate discovery. A new electrolytic zinc plant at Broken Hill should soon be in operation. At Bwana M'Kubwa difficulties in connection with mine layout and equipment have delayed production. Development of the M'Tuga copper mine, now owned by the Falcon company, has continued; and a discovery of gold has been made in the Rhodesian Mineral Concession at Motalla Hill.

The Union Minière du Haut-Katanga, operating in the Belgian Congo, has completed its new reverberatory furnace plant at Panda and has also continued construction work in connection with the leaching equipment.

Prior to the deflection of labor from

current operations to new construction work, Union Minière was producing about 90,000 tons of copper per annum. With the new furnaces in commission this should be increased to 120,000 tons. The new leaching plant should bring the output up to 150,000 tons per annum. With the approaching completion of the Lobito Bay line, the exploitation of the western group of mines (including the Mussonoi) will probably be taken in hand.

Europe, Siberia, Far East and India

By W. A. Doman

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Compared with 1926, mining in Europe showed greater activity in 1927, owing, possibly, to the desire of governments and financiers to develop domestic resources instead of being dependent on foreign supplies. Aluminum, gold, zinc, lead, copper, and tin have all been exploited. Many companies have needed additional capital; and owing to the low price of metals, dividends have been "passed" or paid on a small scale only. In a few industries, such as those of copper, zinc, and aluminum, attempts at amalgamation or trustification have not met with the success expected, largely because the difficulties of coming to an agreement over so large a field are great. Early in 1927, a discovery of radium was made near the village of Lachaux, in France, but no news of importance in this connection has since been published. In the Balkans, a company was formed in August to test deposits of antimony, chromium, and copper. So far, results are not known. A new discovery of bauxite was made in Poland, and a company with a capital of 15,000,000 zlotys was formed to work it. The annual production is estimated to be 2,400 tons of aluminum. The bauxite mines of Jugoslavia have been exporting ore to Hamburg, though the destination was supposed to be America.

Production of zinc has increased to such an extent that the price has fallen, and meetings have taken place in Brussels, in which Cornelius F. Kelley took part, to consider the formation of an international cartel (to operate in Europe) to stabilize the price at £34 a ton. This would be achieved by regulating the production and sales of the metal to about 110,000 tons per annum. Poland during the first half of the year produced 85.328 tons of crude zinc, against 69,789 tons for the corresponding period of 1926. The Silesian mines have to date reached the pre-war level. The Lipine company was able to produce, as its sales are assured by arrangement with companies in Belgium, France, and Germany and with the Harrimans. Russia has also been a purchaser of Polish zinc for some time.

The low price of lead has had an adverse effect on operations at Spanish properties, and many men are out of work. To relieve the crisis it is proposed to form two syndicates embracing those mines already with machinery and plant, and those only recently active. These syndicates were to acquire two foundries, one at Carthagena and the other at Linares. The government agreed to make advances through the Industrial Credit bank, and a federation of producers was formed for selling the metal. To carry the stocks on hand, the State opened a credit of 3,000,000 pesetas, repayable at the end of twelve months. The Linares district was severely affected, the mines being flooded.

The zinc-lead mines of Villemagne have made steady progress, and it was stated that 3,000,000 tons of ore had been developed containing 12½ per cent lead and zinc, and 3 oz. silver per ton. By the end of the year it was expected that the works would treat 550 tons of ore a day.

Base-metal mining has perhaps been most active where copper is concerned, which presumably explains the extension of the international copper cartel, and the difficulty experienced by the French government in disposing of the enormous stocks of the metal collected during the war. Apart from the best-known mines—including Rio Tinto, Tharsis, and Pena—many new properties have come into prominence. A bank at Zurich negotiated the purchase of a copper mine in Austria, situated at Trattenbach, near Gloggnitz. Near Puka, in Albania, mines were discovered which promise a yield of 30 per cent ore, to work which the Copper Mine Puka Albania Company, Ltd., was formed under the auspices of the Serbo-Albanian Bank, with a capital of 5,000,000 gold francs. The Mining Company of Plakalnitza has entered into an agreement with the Franco-American Metal Company—with which the Guggenheims and Harrimans are connected—and the Ekaterine company, in order to acquire important interests in the silver-lead and gold mines of Almeria. The company intends to exploit copper, lead, zinc, and tin. It is reported that the flotation process gives satisfaction. The Mines of Bor, in Serbia, are increasing their treatment works. Exploitation of other deposits has been continued, but with indifferent results.

At Huelva, operations for the first half of the year were satisfactory, and the tonnage developed was equal to that of the corresponding period of 1926. Production was limited by agreement among the producers. The company has a large tonnage of pyrites available, but the status is said to be precarious. Pena Copper has paid no dividend, owing to the loss of a lawsuit against the Commerz Bank, but reserves have been increased. The Penarroya has continued its activities, though it has suffered from the low prices of metals.

A deposit of auriferous ore is announced in Turkey, near Viza, in Ottoman Thrace. La Sospiro Goldfields, in Rumania, is reported to have obtained a loan of £138,564 from the New Consolidated Gold Fields, secured on the concessions and works. A discovery of auriferous quartz was made in Germany between Newlaendel and Putzberg at a depth of about 80 ft.

Tin mining has been mainly confined to Portugal, where the Tamega company has enlarged its works and increased its electric power. In the same district La Compagnie Minière et Financière has exploited a large area rich in tin, where the production next year is expected to be substantial. At Borralha, in the north of Portugal, alluvial stanniferous deposits are also being worked; and the San Finx is producing over 30 tons monthly and has entered the dividend list. The National Mining Corporation, Ltd., has taken an interest in the Lagares Tin Mines (Portugal). Continued development has given good results and a mining plant is now being installed.

Although it cannot be said that mining in Russia and Siberia during 1927 was on an extended scale, it must be admitted that the Soviet government has worked hard to attract capital to its mineral wealth. Native capital, to say nothing of technical skill, is not available, and foreign capital is required. The authorities have discovered that they cannot work the mines themselves, and yet they try to impose conditions that are unacceptable to outsiders. Concessions have been offered in various directions, but the depreciated chervonetz has proved an almost insuperable drawback. Platinum, copper, nickel, manganese, gold, and mica have all been put up to tender; and, after much haggling, contracts have been effected. As regards platinum, the fall in the market price has not stimulated competition. Russia could supply the world's requirements, but when capital is bound down with restrictions it is likely to become shy.

Negotiations were entered into between the Soviet government and Mitsui & Company, of Japan, for a loan. Then the Japanese government became interested, and offered 350,000,000 yen on commercial credits, in exchange for a monopoly for the sale of platinum. This presumably was to run for 24 years, the same as the Mitsui concession, and the Soviet authorities were to be interested in the sale of the metal on the Japanese market. The Soviet refused to agree to the terms. Being still in need of funds, the Soviet deposited large quantities of platinum in German banks, on which advances were made.

The principal copper development was the attempted formation of a trust, under the title of Transcaucasian Copper, to reopen the mines explored in 1917 by a French company at Shagali-Eliar. The ore, it is said, had a mineral content of 12 per cent. These negotia-

tions came to a standstill owing to the condition imposed by the Soviet, which reserved to itself the right of preference for the purchase of the copper extracted. In these circumstances the raising of $5,000,000 for the reopening of the mines created insuperable difficulties. Nothing recently has been heard of the project.

In the matter of manganese, Harrimans has been the principal firm interested. Relations with the authorities concerning the Georgian deposits were said to be cordial, though the workers at one time demanded an increase of wages of 15 per cent. Harrimans claimed that such increase was impracticable. Later, the modifications were granted, and the new contract has a duration of eighteen years. The agreement of the Soviet to the terms was attributed to the break with England.

A further discovery of manganese has been made in the Ukraine, and the ore is said to be richer than that previously found at Nikopol. Negotiations for the development of the aluminum industry in Russia resulted in an agreement with the Aluminum Company of America, giving to the latter an exclusive concession for from 30 to 50 years, according to the amount of capital invested. A New York group has also obtained a concession for working the emerald mines of the Urals. Nickel has been discovered in the Maikop region of the Northern Caucasus, to the exploitation of which Germany is said to be looking forward. The mica deposits in the Bolaibinsk region have been tested.

Activity in Siberia has been mainly confined to Lena Goldfields, which has continued to produce large quantities of gold, none of which, however, has yet reached the shareholders. There is no rush to take up new concessions, as the Soviet has cancelled old ones and has in view the formation of a trust.

The property of the Tetiuhe Mining Corporation is said to be developing well. It is producing about 4,000 tons of flotation concentrates monthly. The company is hampered by the low value of the ruble and by trouble with the workmen. The concession has been modified, and the capital has been raised to £500,000.

Mining in the Far East, excluding Siberia, is mainly confined to tin, though there are a few gold mines. The principal properties are the Chosen and the Oriental Gold Mining companies. Neither is rich, though both earn profits and the latter is paying dividends. Apart from the fact that ore reserves are about 8.5 dwt., and that the engineers expect a good future for the Great Nurupi mine, little interest is taken in the Chosen. At present a margin of profit over working expenses is reported.

The most important tin-producing area of the world is around the Straits Settlements, and with the high price for the metal in 1927, the industry has been prosperous. The companies under white management are the cheapest producers in the world, but about two-thirds of the total output is still derived from Chinese and native-owned mines, worked in many cases by hand labor and primitive methods, so that the costs of the greatest part of the output are still high. It is generally understood that when the metal is below £250 per ton the Chinese rate of profit is reduced to a minimum, and production declines appreciably; a higher price is an incentive to production. With the exception of the Pahang Consolidated, one of the few successful lode mines in existence, the European-owned properties are alluvial and worked by dredges or by hydraulicking. With the former method the costs per cubic yard are very low, in some cases about 3d.; and, as the average tin content is about ½ lb. per cubic yard, the rate of profit is relatively high, so much so that the older companies have extended their areas as far as possible and new companies have been formed to exploit new properties. During 1927 several new dredges were put in operation, and in 1928 more are expected to start work. The general tendency is to run the dredges completely by electricity, and at the present time several old ones are being equipped thus. Production increased in 1927, and it is probable that the year's output will be about 10 per cent greater than that of 1926.

With the Perak River Hydro-Electric Power Company in operation, the tin mines in the neighborhood of Ipoh will be enabled to work their dredges at reduced costs and to turn to profitable account a lower grade of tin-bearing ground. About fifteen well-known English companies are at work in the Federated Malay States, with a production in 1927 of over 38,000 tons of concentrates. The fall in the price of the metal has induced some of the producers to advance a scheme to stabilize the price and control the output. This is not meeting with wholehearted support. It is curious to note that although certain people are trying to control the production of tin, others are at the same time placing orders for several new dredges of larger capacity. The bulk of the tin concentrates produced by the Chinese mine owners is sold on production to the local smelting companies, of which the Eastern Smelting Company is perhaps the most important. For the twelve months to July 31, 1927, it earned a net profit of £74,327 and paid a dividend of 15 per cent. The capital has been raised from £250,000 to £500,000. The quick sales are due to the fact that the Chinese cannot afford to carry stocks of the metal, owing to high cost of production. From their standpoint they do not wish output to be controlled, for fear that accumulations similar to those under the Bandoeng agreement might result.

Increased interest is being shown in tin mining in Siam, and the output of the metal is already having an effect on the general statistics. Bannasan is the principal district, and the railway has proved a great success. The Eastern Siam Tin Dredging Company has secured a tin-bearing area of about 29,000,000 cu.yd. The machinery to be erected will have a capacity for treating 150,000 cu.yd. monthly and is expected to be in operation in January. A Melbourne company is working an area of 240 acres "proved and selected at 19 oz. per cubic yard at 30 ft. deep." It is said that the 240 acres contain 4,000,000 cu.yd. of 72 per cent metallic tin. The dredge capacity will be 80,000 cu.yd. monthly.

Murex, Ltd., has successfully treated the complex ores at the Mawchi Mines, though milling ceased in July owing to the low prices for the products. Material for an extension of the ropeway from the mill to the western veins has been shipped, and an engineer has been sent to supervise its erection. This extension should be working by April, 1928.

Several Australian companies are working tin deposits in Siam and Malaya, but particulars are not available in London. In Indo-China the total production of zinc for 1927 is estimated at about 45,000 tons.

Indian mining in 1927 provided no sensation, whether gold, copper, lead, or manganese is taken into consideration. The companies have gone steadily ahead, and none of them known in London has raised additional capital for extension of operations. The four gold mines on the Kolar field—Mysore, Ooregum, Champion Reef, and Balaghat—have continued to develop and produce, though it cannot be said they have extended their lives. To a certain extent the recovery value from the ore has been less. Mysore and Ooregum, however, have reported excellent developments in parts. The difficulty lies in the greater depths at which operations are being carried on. The Mysore company in December, 1926, treated 19,554 tons of current ore, and together with sand and slimes produced 10,858 oz. fine gold. In October, 1927, 18,305 tons yielded 9,842 oz. gold. Ooregum in October produced 8,263 oz. from 13,000 tons. A fire occurred in this mine early in the year but did not affect results for any length of time. The Nundydroog has maintained a fairly even production. Balaghat at a depth approaching 5,000 ft. revealed satisfactory mineralization. At 4,700 ft., quartz in the South drive was 43 in. wide and assayed 3 oz. 12 dwt. This is a great improvement over the grade of ore struck earlier in the year.

Mining on a small scale for mica, barytes, and asbestos has been in progress. The Burma Corporation reports the Shan and Chinaman orebodies showing well. On the former, No. 7 level, a crosscut at 587 ft. north exposed 9 ft. of ore, assaying 4.1 oz. silver, 0.4 per cent zinc, and 10.7 per cent copper. At the 8th-level crosscut, 258 ft. north,

18¾ ft. of ore assayed 10.7 oz. silver, 20.3 per cent lead, 12.3 per cent zinc, and 0.43 per cent copper. The Chinaman orebody at No. 8 level was crosscut at 1,208 ft. south, showing 41¾ ft. of ore averaging 11.8 oz. silver, 23.5 per cent lead, and 8.8 per cent zinc.

The annual report to June 30, 1927, shows results as follows:

	Year Ended June 30, 1927	Year Ended June 30, 1926
Refined lead, tons	56,791	51,270
Silver, fine ounces	5,088,042	5,216,102

Australasia

By Peter G. Tait
Melbourne Correspondent, Melbourne, Australia

THE gold-mining industry of Australasia was featureless in 1927, with the exception perhaps of New Guinea, which may increase the present rate of production. The Australian output for 1927 will be about 510,000 oz., and adding, say, 100,000 oz. from the Edie Creek-Bulolo River find in New Guinea, makes a total of 610,000 oz. for 1927. This compares with 537,281 oz. for 1926 and 564,849 oz. for 1925. These latter figures include no production from New Guinea, or Papua, which is a new field, comparatively speaking.

Perhaps the principal event of the year was the decision of the Mount Morgan Gold Mining Company to cease production. It is now in liquidation, notwithstanding the fact that the mine contains 8,000,000 tons of ore assaying 1.72 per cent copper and 4.37 dwt. gold per ton. The Wiluna mines, in Western Australia, are still being developed with satisfactory results, and the government is favorable to the construction of a railway to serve the field.

New Zealand's output of gold for 1926 was officially reported as 125,777 oz. The figures for the first nine months of 1927 show a reduction, which suggests that the output for 1927 will be about 115,000 oz. The Waihi Gold Mining Company produces more than half the total output. Other leading producers are the Blackwater, Rimu Gold, Wealth of Nations, and New Big River companies.

Although the recent drop in prices is now affecting production, the 1927 output of silver, lead and zinc will reach the 1926 figures. The Broken Hill mines during 1926 raised 1,296,750 tons of ore. Concentrates produced, including recovery from dump tailings, totaled 251,672 tons of lead concentrate and 274,487 tons of zinc concentrate all of which are shipped.

The lead concentrate goes to the Port Pirie smelters, and the zinc concentrate to the plant of the Electrolytic Zinc Company in Tasmania. In addition to Broken Hill, small amounts are produced elsewhere in New South Wales: an attempt is being made by the National Mining and Camp Bird companies to develop what is said to be a large lead-zinc lode in the Captains Flat mines.

Silver-lead mining in other parts of Australia in 1927 does not call for special comment, although the closing of the Chillagoe State Smelting works, in Queensland, affected production there. The Mount Isa mines are in the development stage. Claims have been made as to the tonnage of ore available; but, compared with Broken Hill, the average value is low. The best that can be expected is that Mount Isa will prove to be a large low-grade property. The Western Australian mines in this class, being low in silver, are nearly all of them closed. Tasmanian mines are producing on a small scale only.

The Electrolytic Zinc Company is maintaining production of its Risdon works at about 1,000 tons of zinc weekly, besides other products. Satisfactory results have followed development on this company's mines on the west coast of Tasmania, which are looked to for supplies of concentrate when the output from Broken Hill decreases. Plans are being prepared for the erection of a mill to treat 2,000 tons of ore weekly. This will be erected at Zeehan, where an experimental mill has been working.

Mount Lyell is the only Australasian copper producer of note. As this is being written, the company is before the Commonwealth arbitration court combating a demand by the unions for shorter hours. It has made clear to the court that, so far as its mining and treatment operations are concerned, no margin of profit exists, and that an increase in cost of production might result in the closing down of the copper mines.

This would create a serious position for the district, which depends solely on the company's operations. The company is spending much capital in driving a haulage tunnel and in the erection of a refinery in an endeavor to reduce costs. Copper produced is sold to Metal Manufacturers, Ltd., New South Wales. The Mount Elliott, in the Cloncurry district of Queensland, has postponed the erection of the new treatment plant, pending the investigation of the porphyry deposits.

Mount Bischoff, in Tasmania, is dying hard. The company is now installing a sluicing plant to treat alluvial areas in the North Valley. The Briseis and Pioneer alluvial mines, on the opposite side of the island, are still working, but the payable areas are rapidly approaching exhaustion. Activity in prospecting for tin continues in Tasmania.

In Victoria, the Mitta Mitta field has attracted attention, and many companies have been floated to develop lode formations. In Queensland, the well-known Herberton district and, in a lesser degree, Stanthorpe have shown signs of a revival as tin-producing centers. Tin has been found in western Australia over a large area in the northwest; the Moolyella and Tabba Tabba deposits, alluvial and lode, are attracting the attention of Australian and British investors.

One of the outstanding events of 1927 was the proving of oil at Roma, in Queensland, in September. Natural gas was discovered there many years ago, but until recently only a belief was entertained that oil existed. Further boring is necessary to decide if it occurs in commercial quantity.

The Broken Hill Proprietary iron mines, at Iron Knob, South Australia, produced 600,000 tons of ironstone in the last annual period. Additional bodies of iron ore are being opened up, and the works are being provided with modern excavating and handling equipments which should insure low operating expense.

The smelting plant of the Hoskins Iron & Steel Company obtains supplies from deposits in New South Wales; but, in addition, the company holds areas in Tasmania, and recently acquired leases on Yampi Sound, Western Australia, doubtless to provide sufficient ore when the new works at Port Kembla reach the producing stage.

A graphite deposit in South Australia is being equipped with a milling and refining plant.

The Western Australian Manganese Company has erected a railroad to provide an outlet from the Horseshoe deposits near Peak Hill. Opal is still produced at White Cliffs and Grawin, New South Wales, and at Stuart Range, in Central Australia.

Japan and Manchuria

By Hironao Nishihara
Mining Geologist, Dairen, Manchuria

MINING in Japan and Manchuria in 1927 resulted in a production in the first seven months of the year as follows: gold, 185,183 oz.; silver, 3,702,683 oz.; copper 77,086,689 lb.; iron, 48,447 metric tons; coal, 17,911,944 metric tons; petroleum, 857,357 bbl.; sulphur, 33,038 metric tons. Compared with the production of 1926 for the similar period this shows an increase of 7 per cent in gold, 3 per cent in iron, 5 per cent in coal, and 33 per cent in sulphur, and a decrease of 4 per cent in copper and 8 per cent in petroleum.

The Taio gold mine made an average monthly production of more than 3,800 oz.; the Kushikino, 2,700 oz. A newly developed gold mine, the Konomai, in Hokkaido, holds the third place, with a monthly average production of 1,860 oz. The Sado-gold mine has been closed several times, but recent reports indicate the discovery of a new orebody that may result in a renewal of operations.

No marked improvement in mining in Manchuria has been noted. The large quantity of crystalline magnesite is still lying idle without finding any market in the outside world.

ANNUAL REVIEW NUMBER

Industrial Progress

Refinements Mark Equipment Lines

By A. H. Hubbell
Associate Editor

A SUCCESSFUL IDEA breeds competition quickly, and this, in turn, breeds other ideas which often improve upon the original. Nowhere is this better exemplified than in the equipment field. It accounts largely for the great activity that is visible, now in one line of manufacture, now in another, in the successive years. A year or two ago the vibrating screen was in the limelight. It is still prominent, but in 1927 the conveyor idler, the power transmission unit, and the lubrication device have attracted more attention. To these might be added the railroad side-dump car, in improving which three important manufacturers have labored. In general, a wealth of ingenuity is evident in the inventions and new models of older machines that have been introduced for mining and metallurgical use. Quality of product is high. Refinement of manufacture is the vogue.

A survey of equipment introduced in 1927 follows. Much of the information given has been obtained directly from the manufacturer. It has been scrutinized with care to avoid repeating the record of old accomplishment.

Rock Drills—The general desire for lighter, more easily handled machines and for greater drilling speed at lower relative cost (more inches of hole per cubic foot of air) has naturally affected the development of new rock-drill models.

A 50-lb. hand-held hammer drill, using hollow steel in hard rock or auger steel in soft formations, was added by Ingersoll-Rand to its line of "Jackhamers." Speed and hole-cleaning ability are claimed for it. The same company introduced a quick and powerful 208-lb. drifter for mining and tunneling work on any mounting. A new type flat valve gives the increased speed. Continuous blowing is provided, cleaning effectively up to 25 ft. A 108-lb. automatically rotated stoper, for raising, overhead stoping, and benching, was also produced by this company.

Several rock drills were announced by the Sullivan Machinery Company. Among these was a 45-lb. rotator for general purposes, which may be equipped with water tube and hose for heavy down-drilling, or with hollow piston for ordinary work. With the aid of cradle and shell the water-tube rotator may be mounted on a column for drifting. The other drills included an auger rotator, a drifting drill for heavy work, a 75-lb. machine for heavy down-hole work, and two stopers.

With the view of developing a more powerful machine than the 118-lb. one-man CP-5 drifter for heavy tunnel work, deep holes and exceptionally hard formations, the Chicago Pneumatic Tool Company perfected its CP-6 drifter. The latter is built on lines similar to those of the former, but with larger bore, and retains the former's general running characteristics. It strikes a harder and even more rapid blow and has been found to have the drilling speed and durability of much heavier drills under the severest conditions. It weighs 136 lb. and is used by many companies as a "one-man" machine.

A 50-lb. hand-held hammer drill (Waugh) was introduced by the Gardner-Denver Company also. (This merger of the Denver Rock Drill Manufacturing Company and the Gardner Governor Company was effected during 1927). The drill is credited with speed, hole-cleaning ability, and freedom from fatiguing vibration.

Of novel design is the new 76-lb. wet stoper which the Cochise Rock Drill Manufacturing Company developed. The water tube of this machine can be removed by loosening two nuts, turning the feed cylinder to one side, and removing the plug; whereupon the water-tube drops out. The air is fed to the cylinder through a port in the hinge bolt. Moreover, by means of a push button the feed may be controlled while drilling or starting.

Diamond Drills—Three new drills, for deeper structure testing, shallow work underground, and putting down 50- to 200-ft. holes, respectively, were designed by the Sullivan company; also new types of core barrel and rods for special work.

Compressors — The introduction of new models of portable units, improved in details and of varied drive, was again the principal feature in this field. A new line in five sizes ranging from 6x6¼ in. to 9½x6 in. was introduced by the Gardner-Denver Company. Each unit is driven by a Buda gas engine of ample power. Another gas-driven portable compressor, in several capacities, was introduced by the National Brake & Electric Company. Two vertically direct-motor-driven compressors of two-cylinder and four-cylinder types were brought out by Sullivan for plants where air requirements are small.

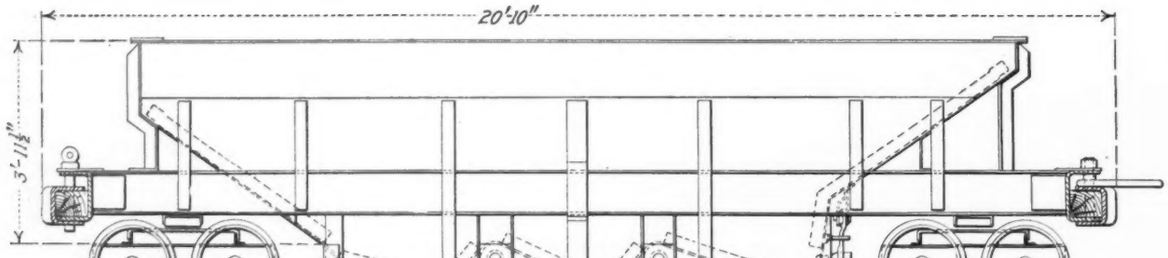
A line of larger sizes of vertical, double-acting compressors, directly connected to its CP-Benz Diesel engines of 80, 120, and 160-hp. ratings, was developed by the Chicago Pneumatic company. The compressors have piston displacements up to approximately 1,000 cu.ft. in the two-stage type for 100 lb. working pressure. The economy of two-stage compression and the low fuel consumption of the driving engine combine to make these units highly efficient. Simplicity, compactness and ease of installation and operation are claimed for them.

Explosives—Further refinements were made in the direction of producing low-freezing explosives; also powders for more economical blasting. The duPont company reports that ethylene-glycol is being used in dynamite to prevent freezing at any temperatures experienced in this country; also that it is using tetryl as a principal explosive ingredient in detonators. The Hercules company introduced six new powders, all approximately 70 per cent by weight, but differing in cartridge count from 240 to 350 1¼x8-in. sticks per 100 lb., thus permitting economy in consumption.

Power Shovels — The outstanding event was the undertaking by the Marion company to build a 15-yd. electric shovel, which is to be strengthened throughout, as compared with the 350 Model, in proportion to the huge dipper capacity. The new shovel will be colossal and the undertaking will be watched with interest. An electric stripping shovel, having a 12-yd. dipper, and said to be the largest ever built, was installed by the same company at a coal property. The trend toward the electric shovel is more marked in the larger sizes, where the steam machine is distinctly passing out.

Likewise, the Bucyrus company constructed for coal stripping a 12-yd. shovel which has the same speed in thrust, hoist, swing, and return as the 8-yd. machine, this being secured by using two independent hoists, one on each side of the dipper, and two swing machinery units; the boom also being supported by cables at the shipper shaft as well as at the point. Bucyrus built a 30-in. Diesel-electric hydraulic dredge also, the drive consisting of four 1,150-hp. oil engines. This dredge is the first of its kind. The usual flock of small shovels appeared, the popularity of the full-revolving type continuing. The Bucyrus company absorbed the Erie Steam Shovel Company, thus greatly increasing its capacity for producing small machines.

Improvements made in underground loading machines involved construction



A new automatic dump car for track gages that are reasonably wide or material that is reasonably fine

details, such as reduction of over-all height and increase in strength of parts. It is rumored that one or two loaders of new types are now in process of development.

Transport — Three new dump cars having similar points of design were introduced. One of these, built by the Differential Steel Car Company for open-pit work, embodies the double-fulcrum principle, the body resting on four points over the bolster side bearings, instead of being held high up over a line of center pivots. This gives strength, stability, and low height, eliminates the locking mechanism, and in general makes for safety. The car is dumped by air, quickly. The door is down-folding. The floor is strongly supported.

A low-loading air-dump car was developed by the Western Wheeled Scraper Company also. This is a dual side-pivot car without locking mechanism and of the drop-door type. The design permits it to be tipped 50 deg. from the horizontal by single-stroke cylinders, the bed returning automatically as the air is exhausted from the cylinders. When extended, the drop doors reach 7 ft. from the center line of the track.

Likewise, the Koppel Industrial Car & Equipment Company brought out an air-operated dump car with drop side and side hinge and with a low center of gravity. Dumping may be done on either side to a point 7 ft. from the track center.

An automatic dump car of a type different from the foregoing was developed by the Sanford-Day Iron Works. It has sides about 17 ft. long and is about 5 ft. 2 in. above the rail. It will hold ten tons of coal and correspondingly more ore. Double trucks permit it to take ordinary mine curves. It can be made lower and longer and in any capacity up to railroad haulage size. Discharge is effected without labor. The car is intended for service where track gages are reasonably wide or where material is reasonably fine. It is shown at the top of this page.

A car dumper of unique construction, built by the Wellman-Seaver-Morgan Company, is operated by rolling it up an incline from the car track to the top of the bin, where it dumps the car carried with it.

Use of duralumin for small mine cars is reported to be extending rapidly in Germany.

Haulage—Some large electric locomotives were built or contracted for in 1927. The electrical equipment of these showed interesting combinations. Chile Exploration will put into service six additional engines, two of them 76-ton units with battery and third-rail connections; four will be 70-ton straight electric engines with both third rail and pantagraph collectors. The electric equipment is of General Electric make. Similarly, the Anglo-Chilean Nitrate Company has twenty-six 30-ton locomotives, in 23 of which trolley and storage-battery types are combined, the remaining three being gas-electric. Utah Copper placed in commission a 75-ton combination trolley-battery locomotive with a horizontal cable reel and 2,500 ft. of cable. The cable reel is centrally placed over the truck framework. All of these are "G-E" equipped.

Westinghouse claims to have built the "lowest and slowest" mine locomotive and also the most powerful. The first is a four-ton gathering engine with an over-all height of 23⅝ in. and a speed of 2¼ miles on the conductor cable and 6 miles on the trolley. The other is a trolley type locomotive that will haul 50 cars, each carrying a 2½-ton load against an average grade of 1 per cent.

A new electric haulage unit that carries its own power plant is the gas-electric locomotive brought out by the Davenport Locomotive Works. The new locomotive has a gasoline engine directly connected to a d.c. generator, which, in turn, supplies d.c. motors mounted on the driving axles. In size it ranges from 4 to 30 tons. Operation is simple.

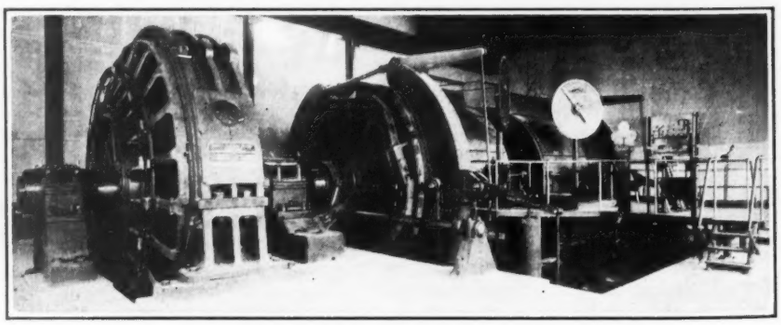
A Diesel locomotive, in sizes from 10 to 50 tons, was introduced by the Plymouth Locomotive Works. The power plant is a 77-hp. Atlas Imperial full Diesel engine.

A three-ton battery locomotive with interesting features was built by the Atlas Car & Manufacturing Company for the Horne Copper Corporation. This machine is very compact, but retains the standard arrangement of two motors, one driving each axle. The Milwaukee Locomotive Manufacturing Company improved the design of its Type H gasoline locomotive (4 to 20 tons).

A trolley frog for hard service in mines, a new trolley splicer, and several devices for electric haulage service were introduced by the Ohio Brass Company.

Hoisting—The new electric hoists at Anaconda's Belmont mine were placed in commission. The Nordberg Manufacturing and General Electric companies furnished the equipment. Both machines are designed to hoist from 5,200 ft., the main hoist raising 146.3 tons per hour; the other is the chippy hoist. The main hoist is the largest one in Butte and the chippy the largest of its type there. The hoists are driven respectively by a 2,150-hp. and a 1,050-hp. shunt-wound motor.

Nevada Consolidated's new mine hoist, equipped by Westinghouse, has full magnetic type control with primary pneumatic reversing switches. It is designed for unbalanced operation and continuous duty. Another interesting hoist of 1927 is that installed by the

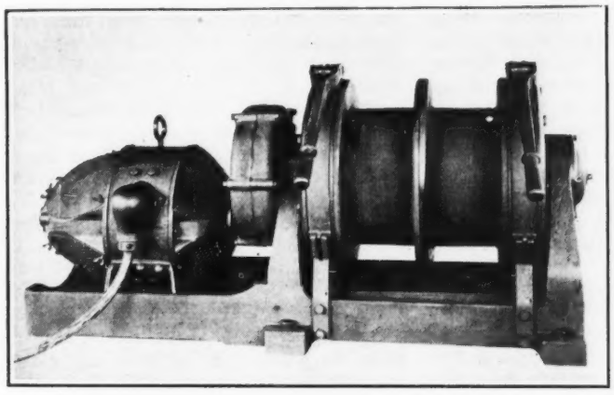


The new electric hoists at Anaconda's Belmont mine

Canadian Ingersoll Rand Company for the Horne Copper Corporation in the Rouyn district.

A double-drum electric hoist which is operated semi-automatically from a push-button station with liquid control was built for the Michigan Alkali Company by Allis-Chalmers. It is said to be the first of its kind. The hoist is geared to a 375-hp. induction motor and is started by the loader at the loading station by means of a push button. The hoisting cycle thereupon proceeds automatically.

A number of small hoists for slushing and other work appeared. Ingersoll-Rand added to its "Little Tugger" group a 275-lb. hoist carrying 300 ft. of ⅜-in. rope. It is operated by air or steam. The Sullivan Machinery Company introduced two more-powerful electric hoists (15 and 25 hp.) for slushing to



A new powerful slusher hoist (15 to 25 hp.). Note that the motor is on the outside at one end

supplement the 6½-hp. hoist previously in use. In this machine the motor is on the outside at one end. Hoist and motor are built straight in line to facilitate moving up a raise. See the illustration.

Hoist and Other Control—Improvements in previous designs of electric controlling devices were made by the Cutler Hammer Manufacturing Company. A new magnetic blowout is now being used on d.c. magnetic contactors for automatic motor starters, mine hoists, and similar applications. Likewise, an individual oil dash pot with an electrical contact for attaching to a.c. magnetic contactors has been developed. This research work has been extended to drum type and other manual controllers, an improved self-lubricating drum controller segment being developed. A line of magnetic shoe brakes for direct and alternating current was also brought out. The tendency in large high-speed mine hoists is toward the variable voltage, direct-current type using a flywheel motor-generator set. Such a controller was built for one of Anaconda's hoists.

Pumps—Refinements were made in details, the object being to better the pump as a unit so as to secure greater efficiency, ease in handling, and smooth running. Few important changes were reported in mine and mill pumps. The Krogh Pump & Machinery Company introduced a ball-bearing centrifugal vertical unwatering pump that is direct-connected to an electric motor. The shell is split vertically, facilitating inspection and removal of parts. The pump is made in capacities of from 300 to 650 gal. per minute and for any head up to 700 ft. Another interesting installation was the centrifugal turbine dewatering pump built by the Pomona Manufacturing Company for a Colorado mine. The pump was installed at a depth of 700 ft. with two sets of turbines below the pump head, the lower for raising the water to the motor level and an auxiliary set for boosting it to surface. The pump was made corrosion-proof with acid-resisting metal. Water lubrication was used. A strong, light non-corroding pipe of sulphate wood fiber for pumping service was brought out by the Brown Company.

Crushing, Grinding—Although nothing radically new was reported, installations of interest were made. The Georgian Manganese Company, in Russia, installed in its new mill a set of 36-in. Garfield rolls, made by Allis-Chalmers. Both of the driving pulleys and their belts are placed on the same side of the machine. A 6½x12-ft. rod mill installed at the New York Zinc Company's mine by Allis-Chalmers has special features, including primary Wuest gear drive and direct connection to a high-speed 240-hp. synchronous motor. The latter is accomplished through a Falk herringbone speed reducer inclosed with a magnetic clutch. The motor has a direct-connected exciter and is provided with a start-and-stop push-button station with a complete protection system for automatic operation. The same machinery company installed at Chuquicamata the two 60-in. gyratory crushers ordered last year and reports that they show a capacity of 3,000 tons per hour each. The Straub Manufacturing Company has eliminated gearing on its stamp mills and is using a direct-belt drive. Its ball mills are now fitted with manganese-steel liners. Improvements have also been made in the crushing and pulverizing mills of the Standard Equipment Company. F. O. Williamson claims that Williamson mills in the past year have demonstrated a higher efficiency and a lessened grinding cost.

Crushing rolls of the four tension rod type, 78x24-in. in size, were installed by the Traylor company at a Western plant. One of these is set to 1¼ in. and crushes 700 tons per hour; the other, set at ⅜ in., crushes 500 tons hourly. A 15-in. machine was added to the company's line of Bulldog finishing gyratory crushers.

Coal-pulverizing equipment introduced included the Hardinge unit pulverizer, consisting of the standard slow-speed conical ball mill and the reverse current air classifier, the combination giving continuous operation, control of fuel fed to the burner, and constant fineness of product. The Erie City Iron Works also developed a system of feeding pulverized coal to low-setting boilers.

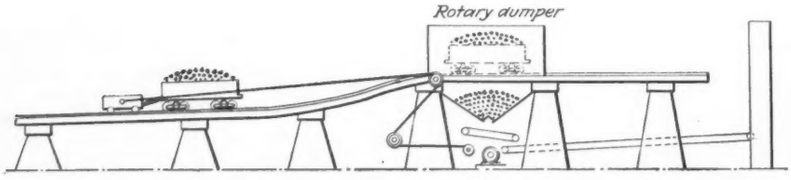
Screening—The development during 1927 of the Presslock crimp process of weaving wire screens in the coarser meshes was a notable advance, according to the W. S. Tyler Company. Greater economy is thus attained, the wires are kept from shifting, a free screening surface is presented, and the life of the screen is lengthened. The company developed a new model of the Hum-mer vibrating screen suitable for the small operator. It also published a textbook entitled "Woven Wire Screens," which should be valuable to engineers. The company reports that it has been found advantageous to use screens in connection with cone crushers.

Three new vibrating screens were introduced. One was developed by U. S. James after long tests and is being made by the Norwood Engineering Company in both wet and dry types. Another was the Deister Plat-O screen, the vibration of which is produced by a pair of unbalanced pulleys. The third was made by the Cottrell Engineering Company of Los Angeles.

Conveying—The trend in design of conveying and elevating machinery has been toward larger units and lower friction losses, with resulting decrease in operating costs and power consumption. Stephens-Adamson designed a feeder of mammoth proportions for a foreign mining company. It will handle a steam-shovel product at a rate of 1,500 tons an hour. The load is carried on heavy 18-in. pitch and 72 in. wide cast-steel pans. The company also developed a live roll grizzly combining both feeding and screening actions on bulk material.

An interesting innovation in conveying practice is the duplex belt system of the Boston Woven Hose & Rubber Company, in which two belts are used—a carrier belt, which is not in tension, and a transmission belt, on which the carrier belt rides.

Attention was devoted by several makers to improving the conveyor idler, principally in the matter of lubrication. The Link-Belt Company introduced an "anti friction" idler with Timken bearings; the Stearns Conveyor Company, an idler having a chilled face; Stephens-Adamson brought out a Timken-equipped unit carrier; and the Hydraulic



A rotary car dumper used with a belt conveyor for loading material into ships

Pressed Steel Company developed heavier models of the Mellin conveyor idler.

The first installation of a rotary car dumper in conjunction with a belt conveyor for loading material into ships was made in Baltimore. The dumper was a Wellman-Seaver-Morgan product.

Blowers, Fans—Construction of two sets of motor-driven centrifugal compressors to furnish a large volume of air at low pressure for flotation work was completed by General Electric for the Nevada Consolidated Copper Company. Each will consist of a 1,250-hp. synchronous motor driving a blower rated at 60,000 cu.ft. per minute of 3.4 lb. equivalent sea level rating. This means actual delivery at 2¼ lb. because of the altitude.

A new heavy-duty blower was produced by the Connersville Blower Company. In it are incorporated a new flexible-tooth gearing, high inertia impellers, and a renewable split sleeve bearing that permit the blower to run at higher speeds and at higher pressures than have heretofore been practical. Direct coupling to motors is now feasible. This development is expected to affect the application of rotary positive blowers to flotation and other processes where it may be used. The Coppus Engineering Corporation introduced a portable self-contained blower intended for cooling hot corners and places in a plant. It is mounted on a tripod.

Classification—Owing to the increased importance of large circulating loads between mills and classifiers in closed circuit grinding, as a means to securing maximum efficiency, all models of the Dorr classifier were made heavier and in general were redesigned along more rugged lines to meet the new requirements. The bowl classifier was stiffened structurally and otherwise improved in design.

Concentration—At the new pilot mill of the Georgian Manganese Company, in Russia, a Hancock jig has been installed. Because of the large amount of concentrate produced when handling manganese ore, and to conserve the water, the central hutches are provided with Borcherdt dewatering discharge screws, which deliver the concentrate with little loss of water. The tailings are discharged by a continuous drag conveyor to conserve water also.

A triplex plateau (Plat-O) table has been developed by the Deister Machine Company from a rougher to a point where it has a much wider application. The Cottrell Engineering Company has strengthened and improved its pneumatic dry concentrator. The machine has been applied to work in the nonmetallic field.

Air Separation—A new line of separators has been developed by Rubert M. Gay Company, New York. The old gravity or air separation principle is used for the preliminary reduction of the coarsest oversize only. It is followed by centrifugal sizing in a chamber like that of the original Gayco to which a third sizing zone in and within the fan path has been added. The centrifugal pump is entirely new.

Flotation—New developments here were few. The General Engineering Company proceeded with the marketing of the MacIntosh flotation machine, which it had taken over the year before. In this machine, by using a revolving canvas-covered rotor through the walls of which air is introduced into the cell, the inventor has avoided the difficulty caused in the older pneumatic cells by deposition of lime in the blanket. Another cell was introduced by the Butchart Manufacturing Company in the Joplin district. In this the air is first introduced into a stationary, horizontal canvas-covered chamber, of triangular cross section, through the walls of which it passes into the cell. Below and outside of this canvas-covered member are two horizontal revolving shafts, with vanes, which keep the pulp in motion.

A flotation reagent feeder (the Geary), which will handle any liquid reagent and feed it at any rate from ½ c.c. to 1,000 c.c. per minute, was introduced by the Galigher Machinery Company. To regulate the feed, a metal cup containing the reagent is lifted, lowered, and tipped in guides on the principle of the mine skip.

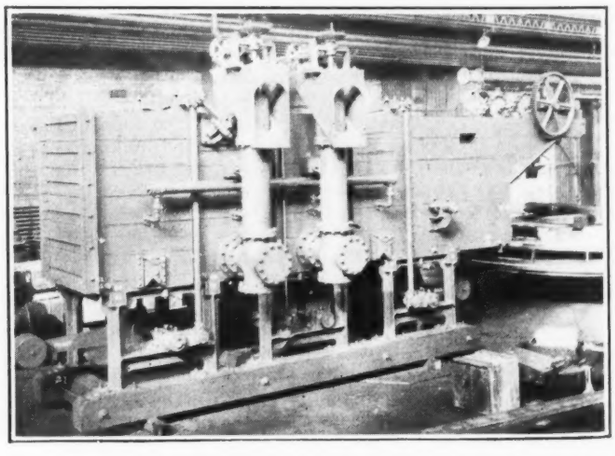
The line of standardized factory-built complete flotation plants introduced by the Southwestern Engineering Company was extended and enlarged. A self-contained fine-grinding and flotation plant, of 20 to 30 lb. per hour capacity, was developed by the General Engineering Company for laboratory service.

Filtering, Thickening—The Dorr Company introduced a continuous drum filter (the Dorrco) of a distinctly new type, in which the cake is formed on the inside surface of the drum instead of on the outside. A tank is not required, the drum serving as such. Settling and segregation take place in the same direction as filtration. The company's traction thickener, moreover, is now offered as a standard type in sizes from 20 ft. in diameter upward. The Bradley automatic density valve was produced in new 400- and 1,200-ton sizes by the Thyle Machinery Company. Another new size (Type AB) was introduced with the floating chamber cast in antimonial lead and with top and bottom head members of cast iron lined with No. 10 sheet lead. This last is intended for highly corrosive solutions.

Roasting—The Nichols Herreshoff furnace was built in new large sizes having a greater capacity than other multiple hearth roasters, the Nichols Copper Company claims.

Smelting—At the U. S. S. lead refinery at Grasselli, Ind., a new modification of the pig lead casting wheel was devised.

Refractories—In the field of refractories, both for metallurgical and power plant furnaces, the outstanding event was the adoption by the American Refractories Institute of a set of standard rules and formulas that will serve to place the buying and selling of special firebrick shapes upon a scientific basis. The General Refractories Company introduced a firebrick (Biasbrix) that, it is claimed, will make a wall that will not loosen up. These brick are laid on the bias, one overlapping and tying three others together in a natural self-locking construction. The Botfield Refractories Company brought out the Adamant gun for maintaining a furnace lining by surfacing it with a mixture of "Adamant" firebrick cement and "Adachrome." The



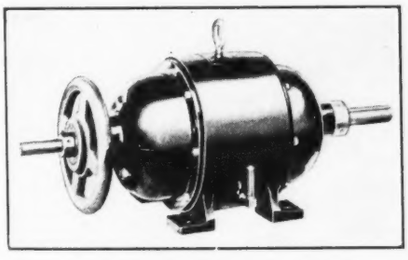
One of the Hancock jigs, equipped with Borcherdt dewatering discharge screws, that was built for the Georgian Manganese Company

gun is compact and weighs 4 lb. It is operated by compressed air at 60-lb. pressure, one man being needed.

Power Plant—The trend of steam practice continues in the direction of higher steam pressures and the use of air preheaters and other up-to-date accessories. Some large steam turbines were built. The capacity of the turbo-generator far surpasses its nearest rival, the water-driven generator, but is still growing rapidly, according to the Westinghouse company. Turbines of the bleeder type for generating both power and process steam may be had in larger sizes.

Two applications of the oil engine have won new prominence during the year. These are the direct-connected oil-engine-driven air compressor and the oil-electric locomotive. The former affords the most economical method of producing compressed air today, according to Ingersoll-Rand. In the latter the economy of the oil engine has reduced the cost of switching and hauling cars. Diesel and semi-Diesel engines made a slight gain in general in the mining field. The Fairbanks-Morse Company introduced a line of block-cylinder type Diesel engines of higher speed and lighter weight, rating from 30 to 180 hp.

The Chicago Pneumatic Tool Company undertook to make, under license, a four-cycle, high-compression, solid injection Benz Diesel engine. This engine may be had with two, three, four or six cylinders rated at 80, 120, 160, and 240 b.hp. The 80-hp. engine weighs 170 lb. per horsepower, as against 100 lb. per horsepower for the 240-hp. Diesel. (Use of the Benz Diesel for driving compressors is described on p. 139.)



A new variable speed gearless transmission (see text)

Motors—Several new electric motors were introduced. Fairbanks-Morse brought out a line of self-ventilated inclosed motors with an air cleaner feature. Perhaps the most important motor developed was the new rugged shovel-type motor built by General Electric. Hitherto mill type motors have been customarily used in shovel service.

Crocker-Wheeler built four (2-2,400 kw. and 2-1,940 kw.) large three-unit motor-generator sets with direct-connected exciters for the Raritan Copper Works. Westinghouse introduced a 300-hp. totally inclosed motor with forced ventilation, for use where the air contains grit, water, or dangerous gas. The Wagner Electric Corporation brought out a line of air-jacketed motors for similar service.

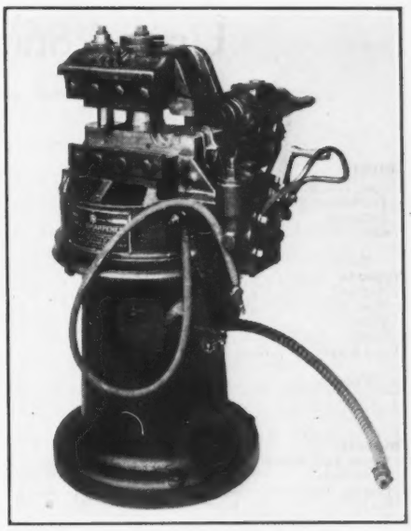
Power Transmission—An interestingly large number of speed reducers, transmissions, gears, and couplings came on the market. The Link-Belt Company's contribution consisted of a reducer in standard units to cover a wide range of ratios and capacities. Its subsidiary, the H. W. Caldwell & Son Company, brought out a self-contained reducer which combines a Link-Belt silent chain drive from the high-speed shaft and a cut spur-gear drive to the low-speed shaft. Abroad, a positive-driven change gear was developed by the P.I.V. Syndicate, London, in which gear it is possible to alter the speed ratio between a driving and a driven shaft to an infinite degree within the range of the gear.

Stephens-Adamson Manufacturing Company introduced the JFS variable-speed gearless transmission. Power received at constant high speed is delivered at a reduced speed, which can be varied by turning a small hand wheel for operating various machines. The transmission is inclosed in a dust-tight housing and operates in a constant bath of oil. It resembles a totally inclosed motor. It is made in sizes to transmit ½ to 15 hp. (See the cut on the left.)

New standardized lines of herringbone-gear speed reducers and flexible couplings were brought out by the Falk Corporation. The improvements in these reducers consist in better bearings, frames without ribs and pockets inside the gear case, the self-lubricating system, and in the standardized gear ratios and motor beds.

R. D. Nuttall Company developed a series of reduction gear units for heavy service (150 to 2,000 hp.). A rigid stud compression connector having a rigid stud base and a cap unit with a concave surface was brought out by the Delta-Star Electric Company, also a heavy duty busbar clamp for metallurgical plants and others using heavy currents.

Lubrication—It is doubtful if any phase of machinery operation is receiving more attention today than that of lubrication. Greater efficiency and economy in use of lubricants is being sought. This is true of all machinery, and particularly, in mining, of mine car wheels and belt conveyors, which carry the ore at the various stages of production and treatment. The adoption of anti-friction bearings has made it advisable to lubricate with a solidified oil in sufficient quantity to cover the balls or rollers and their raceways. This has led to pressure lubrication and the use of pressure fittings. Most prominent in this development has been the Bassick Manufacturing Company, and its Alemite products. A still later development is that of dispensing lubricating grease from a central point to all parts of a machine or to several machines in a group. Several manufacturers have made efforts along this line, with varying success. Among them are the Carr Fastener Company, makers of the Dot-O-Matic equipment; Ideal Lubricator Company; the Industrial Oil Equipment Corporation, and the Keystone Lubricating Company.



A semi-portable drill steel sharpener weighing only 1,430 lb.

Bearings—Use of anti-friction bearings on mine cars, conveyors and heavy mining machinery has had good results, and further improvements are in progress. The SKF spherical bearing, of high carbon-chrome steel, hardened throughout, is a self-contained, non-adjustable, and self-aligning unit. During 1927, among many applications, these bearings have been used in various interesting ways in the mining field.

New applications of tapered roller bearings made by the Timken company have increased, the most striking being in the case of mine cars. The standardized loose-wheel mounting originally developed for cars used in extracting coal is being adopted by some prominent metal-mining operators.

Recording Instruments—A large number of indicating, recording, and controlling instruments appeared. Interesting among these was the so-called continuous carbon monoxide recorder, of the Mine Safety Appliances Company.

The Shop—A light-weight (1,430 lb.) semi-portable drill steel sharpener was brought out by Ingersoll-Rand. Black & Decker Manufacturing Company reports the development of two shop tools—a ½-in. ball-bearing electric drill and a portable electric hammer. The Buffalo Forge Company introduced a "Universal" iron worker, with punch, shear, and bar cutter for repair and maintenance. A power machine for cutting, reaming, and threading ½- to 2-in. pipe and an automatic pipe cutter for 2- to 4-in. pipe were put on the market by the Toledo Pipe Threading Machine Company. A wide variety of equipment for electric and gas welding was introduced, in particular for automatic work.

United States Commerce in Ores and Metals

Eleven-Month periods ending with November. Figures in pounds, unless otherwise stated

I—Copper

	1926	1927
Imports		
Ore, concentrates, matte	137,098,172	157,062,910
Unrefined, black, blister	418,318,017	400,071,765
Refined	150,597,845	100,117,593
Old	10,442,134	5,968,085
Total	716,456,168	663,220,353
Exports		
Refined	771,043,399	831,879,317
Rods	40,090,790	52,863,366
Wire	12,393,405	9,604,345
Cable	17,282,589	21,040,789
Other forms, including scrap	23,976,329	50,073,395
Total	864,786,512	965,461,212

II—Lead

Imports		
In ore and matte	101,684,239	77,018,251
In bullion	140,976,898	219,695,844
In pigs, bars and other forms	18,461,987	4,883,979
Scrap, babbitt, etc., lead content	1,971,255	1,126,100
Type metal, lead content	6,555,160	652,491
Total	269,649,539	303,376,665
Exports		
In pigs and bars—		
From domestic ore	7,463,100	4,466,428
From foreign ore	119,256,844	216,732,290
Manufactures	23,784,970	8,946,485
Total	150,504,914	230,145,203

III—Zinc

Imports		
Ore (duty paid)	27,133,259	18,777,412
Ore (duty free)	116,572	1,650
Blocks and pigs	40,027	47,787
Total	27,289,858	18,826,849
Exports		
Ore concentrates and dross	20,607,875	8,429,685
Slabs, blocks and pigs	76,226,566	89,140,342
Sheets, strips and other forms	8,696,796	7,250,015
Zinc dust	1,985,201	2,440,792
Other zinc manufactures	2,219,200	2,553,293
Total	109,735,438	109,814,127

IV—Gold and Silver

Imports, 12 months		
Gold, value	$213,504,000	$207,535,000
Silver, value	69,596,000	55,074,000
Exports, 12 months		
Gold, value	115,708,000	201,455,000
Silver, value	92,257,000	75,625,000

V—Exports of Minor Metals and Minerals

Aluminum: Ingots, scrap	535,049	3,265,594
Manufactures	8,412,477	11,489,634
Nickel, metal and alloys	1,481,100	1,926,690
Platinum, oz	9,976	18,512
Tin bars	1,331,303	1,821,971
Tin manufactures	5,307,779	6,062,253
Asphalt and bitumen, tons	31,451	34,082
Manufactures of, lb	46,172,442	57,352,017
Sand and gravel, tons	346,003	356,196
Cement, bbl	884,250	754,732
Fireclay, tons	39,282	39,785
Other clays, tons	34,684	42,114
Asbestos, tons	701	233
Asbestos manufactures	8,723,824	10,793,149
Gypsum and manufactures	54,642,140	34,614,153
Mica and manufactures	2,197,545	2,725,503
Sulphur, tons	531,665	735,795
Salt, tons	141,959	144,267
Graphite and manufactures except crucibles	3,949,921	3,373,227
Phosphate, tons: High grade hard rock	98,422	127,174
Sand pebble and other phosphate rock	608,477	734,796
Borax, tons	13,373	33,402
Ocher, umber, sienna, whiting, etc., tons	14,625	17,421
Magnesia and manufactures	5,903,914	5,211,197

VI—Imports of Minor Metals and Ores

Aluminum, metal, scrap, and alloy	67,185,483	63,265,298
Antimony in ore	3,017,268	3,631,343
Metal	27,371,254	23,238,306
Cobalt	487,650	453,412
Platinum, oz	108,339	118,827
Iridium, oz	3,074	4,571
Osmium and osmiridium, oz	5,992	6,944
Palladium, oz	7,732	5,236
Rhodium and ruthenium, oz	1,700	1,328
Quicksilver	1,960,430	1,705,890
Nickel: Ore and matte	12,927,138	10,744,474
In pigs, ingots and other forms	26,739,543	27,296,739
Manganese ore, tons	320,407	273,568
Chrome ore, tons	204,220	203,674
Tin, bars, blocks, pigs, tons	79,270	75,317
Tungsten	3,229,168	1,566,882
Ferrochromium, chromium metal and chrome-vanadium	1,174,967	995,985
Ferrosilicon (silicon content)	26,394,170	15,602,664

VII—Imports of Non-Metallic Minerals

Bauxite, tons	268,118	330,512
Marble, cu.ft.	804,110	905,985
Sand and gravel, tons	777,854	644,142
Lime and limestone, tons	24,576	24,217
Kaolin, china and paper clay, tons	325,590	274,587
Other clays, n.e.s.	79,242	50,879
Corundum, tons	4,153	1,133
Emery, tons	4,237	2,726
Flint, tons	12,911	13,091
Asbestos, unmanufactured, tons	210,125	184,886
Asbestos, manufactured, tons	29,395	65,273
Cryolite, tons	7,529	5,063
Chalk, crude, tons	90,754	104,462
Fluorspar, tons	60,471	59,433
Gypsum, crude, tons	679,399	685,657
Mica, crude	760,995	688,512
Mica, cut, split	5,974,033	2,416,223
Diamonds, rough, carats	223,435	212,635
Cut, unset, carats	513,446	406,119
Pyrites, tons	349,378	242,073
Talcum, steatite, French chalk, tons	22,784	23,493
Magnesite, tons	86,868	54,436
Salt, tons	59,509	45,547
Graphite	29,367,002	32,695,145
Mineral wax	7,811,648	6,862,328
Iodine, crude	641,089	881,017
Nitrate, sodium, tons	850,634	682,236
Ochers and sienna	20,086,861	19,157,373
Lithopone and other zinc pigments	18,066,797	18,362,286
Potash, tons: Crude chloride	178,798	158,190
Crude sulphate	63,313	62,383
Kainite	151,498	96,704
Manure salts	280,727	258,049

VIII—Iron Ore and Pig Iron

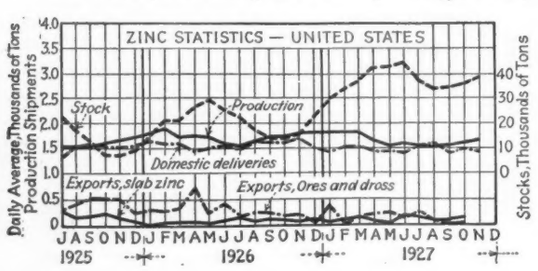
Exports		
Iron ore, tons	868,405	897,282
Pig iron, tons	22,557	47,913
Imports		
Iron ore, tons	2,350,406	2,488,879
Pig iron, tons	430,990	118,269

Slab Zinc Production, 1927

(In tons of 2,000-lb.)

	Quarter				
	First	Second	Third	Fourth	Total
Illinois	29,895	27,092	24,433	28,305	109,725
Arkansas	8,655	7,656	5,033	5,463	26,807
Kansas-Missouri	8,302	8,747	8,619	8,730	34,398
Oklahoma	34,930	30,256	28,882	29,208	123,276
Electrolytic	27,873	28,951	27,839	27,966	112,629
Other states	53,821	52,032	48,800	52,060	206,718
Total	163,476	154,734	143,606	151,732	613,543

Production, Stocks, Imports, and Exports of Lead and Zinc


ZINC STATISTICS — UNITED STATES
Daily Average, Thousands of Tons Production Shipments
Stocks, Thousands of Tons
Stock
Production
Domestic deliveries
Exports, slab zinc
Exports, Ores and dross
J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D
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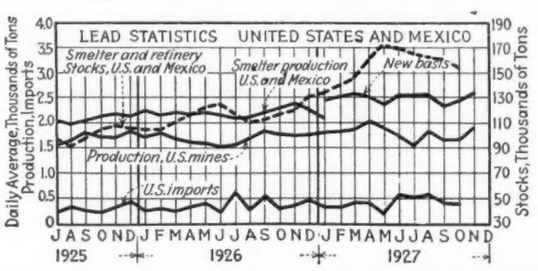

LEAD STATISTICS UNITED STATES AND MEXICO
Daily Average, Thousands of Tons Production, Imports
Stocks, Thousands of Tons
Smelter and refinery Stocks, U.S. and Mexico
Smelter production U.S. and Mexico
New basis
Production, U.S. mines
U.S. imports
J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D
1925
1926
1927

ANNUAL REVIEW NUMBER

Railroad Transportation

By F. R. Raiff
Vice-President, A. S. & R. Co., New York

FREIGHT movement in 1927 was satisfactory and without material delays or embargoes, except for the interruptions occasioned by floods and wash-outs in the Mississippi Valley, in New England, and in Colorado. Manufacturers and merchants have adapted their stock requirements to this more orderly and dependable freight movement and are buying in smaller quantities, and correspondingly reducing their inventories.

The volume of traffic handled by the railroads supplies an excellent yardstick by which to measure the business conditions of the country. To the week of Nov. 12, inclusive, the loadings of revenue freight for the current year totaled 46,473,139 cars, a decrease from the same period of 1926 of 1.83 per cent, and an increase over the same period of 1925 of 2.04 per cent.

On Nov. 8 the Class I roads had a surplus of 207,757 freight cars in good repair and immediately available for service, sufficient to take care of any probable demand. For the first ten months, 66,364 new cars were placed in service and, on Nov. 1, 11,136 were on order.

The average daily movement of freight cars for the first nine months was 30.2 miles, the highest yet attained for any corresponding period. Average load per car was 27.3 tons, an increase of 0.2 ton over the corresponding period in 1926.

Net railway operating income of Class I roads for the first nine months was $83,000,000 below that for the same period of the previous year, the rate of return on property investment being 4.61 per cent, as compared with 5.22 per cent in 1925.

None of the major proposals by the carriers for the consolidations of the various railroads have as yet had the approval of the Interstate Commerce Commission, and it seems improbable that that body will take definite action until Congress has had opportunity for further legislative enactment. Representative Parker, of New York, chairman of the Commerce Committee in the House, has stated that a revised consolidation bill will be presented in the House at the coming session, and that hearings will be held by the committee, and it is expected that the Fess bill, similar to the Parker bill, will be taken up in the Senate.

No material changes have been made in the general rate schedules as affecting the non-ferrous metals, except for the general advances made on Jan. 27 by the lines east of Chicago and north of the Ohio River in the rates on refined copper, the Chicago-New York rates having been advanced 25 per cent and other rates within that district having been advanced at the same time in proportion.

Two vacancies are expected to occur in the Interstate Commerce Commission: the resignation of Commissioner Hall and the expiration of the term of Chairman Esch on Dec. 31. It is to be hoped that Mr. Esch will be reappointed and confirmed, and that in appointing a successor to Commissioner Hall the selection will go to some member of the Commission's staff, of whom there are several well qualified by seasoned experience to handle the work ably and to carry on those matters so competently handled by Commissioner Hall.

Labor

By H. D. Keiser
Assistant Editor

FOR both employers and employees, the labor situation during 1927 in the metal mining industry was unusually satisfactory. In most of the districts, skilled and unskilled labor was plentiful throughout the year, and at the same time there was little unemployment. Wage scales were practically the same as in 1926. Also, not a single strike occurred. The absence of serious labor trouble in the industry reflected the general labor situation of the country, as revealed by the U. S. Bureau of Labor Statistics. Reports of this federal agency show that during 1927 fewer labor disputes resulted in strikes or lockouts than in any of the preceding eleven years. Another outstanding development in the labor situation of the industry was the increased interest in accident prevention and welfare work.

In the Southwest, the proposal to apply immigration quota restrictions to Mexico evoked considerable discussion, it being claimed that the proposed legislation would admit only 1,500 Mexicans a year and that this number would be insufficient for the needs of the region. Secretary of Labor Davis, in dealing with the subject in his annual report, which recently appeared, suggested that the mining and other industries of the Southwest, using such labor, should adopt a joint agency system for the conservation of labor by transfer from one job to another.

At the large copper camps of Arizona, labor conditions were normal, no shortage or unemployment being experienced.

Graph shows marked decline in 1927 of labor disputes in United States resulting in strikes or lockouts.

Standardization of mining methods made easier the training of men to fill special positions. The tendency in all of these camps, except Bisbee, was toward a greater percentage of Mexican miners. In the smaller camps, as a result of sporadic work, conditions were not as satisfactory, there being no scarcity of labor, but considerable unemployment. This was particularly true in the camps tributary to Kingman and Prescott. Numerous wage scales, most of which served merely as bases for bonus systems, prevailed. In Bisbee, Miami, and Jerome, where the same base rates were in force, the rate for muckers was $4.40 a shift; for miners, $4.95; and for timbermen, $5.23. Many of the skilled workers, as a result of bonus schedules, however, earned twice these base rates. Accident prevention, first-aid, and mine rescue work were given close attention by all the larger companies, and the accident record of the state, with the exception of one serious disaster—the mine fire of the Magma Copper Company, in which seven men lost their lives, the latter part of November—was notable. The Phelps Dodge Corporation, in particular, continued to make remarkable progress in reducing the number of serious and fatal accidents at its properties.

A shortage of competent miners and timbermen, and a surplus of common labor, existed in practically every mining district of Idaho, during the summer months, but winter conditions brought about a large surplus of all classes of labor, and the turnover rate receded to a record low point. Wages, as in previous years, were fixed by a sliding scale based on the price of lead. Since early in the year, however, when the price of lead dropped below 7½c., operators voluntarily disregarded the sliding scale, and held miners' wages at $5 and the corresponding rates for all other employees. In the Coeur d'Alene district, operators continued to maintain a mine rescue car in charge of a safety engineer, devoting his entire time to the adoption of safety measures and to training employees in first-aid and mine rescue work. The Hecla Mining Company provided a baseball park at Burke for its employees, and the community took steps to construct a public swimming pool. Besides the Hecla company, the Federal Mining & Smelting Company and the Bunker Hill & Sullivan Mining & Concentrating Company have provided modern clubs and other facilities for employees and the communities dependent on their operations.

Throughout the year, all of the mines in the Michigan copper district had well-balanced and efficient forces, and labor conditions were better than they have been in years. Improvement was particularly noticeable in the Calumet area, where many empty houses were reoccupied. On Oct. 1 a total of 7,832 men were employed in the mines, mills, and smelters of Houghton County. This was the largest number on the payrolls since 1920. Wages for company laborers and miners were $3.80 and $4.20 a day, respectively. Contract workers, however, earned from 50c. to $1.50 a day more than these rates. More attention was given to safety in the mines than ever before, and safety measures were in evidence at all the properties. During the year ended Oct. 1, there were only six fatalities, representing a percentage of only 0.0012 of the total number of men employed. One of several precautionary practices adopted was the training of men to fight underground fires. About 150 trained men, who can be summoned quickly in an emergency, have been made available by this measure. The various mining companies of the district have been alert to the needs of their respective communities, and have supported or contributed liberally to the maintenance of hospitals, schools, libraries, churches, swimming pools, and community centers.

Labor was plentiful throughout the year on the Lake Superior iron ore ranges, owing largely to the fact that since scrapers have been generally adopted in underground operations smaller crews have been employed. The wage scale remained unchanged.

No labor trouble of any kind occurred in the Tri-State district. At the close of the year, the wage scale, which fluctuates with the price of zinc concentrate, was as follows: millmen, $4 a ten-hour shift; mill helpers, $3.50; machine miners, $4.25; machine helpers, $3.75; hoistermen, $4.50 to $4.75; and shovelers, 10c. to 15c. a 1,200-lb. can. The accident-prevention department of the Tri-State Zinc and Lead Ore Producers' Association functioned efficiently in reducing the severity of accidents and increasing the rock tonnage mined per accident. Safety campaigns were emphasized and excellent records for continuous operation without a lost-time accident were made by many companies.

Montana was entirely free of labor trouble; in fact, no labor dissatisfaction has occurred in the state since the war. The wage scale for miners was $4.75 a shift, but in Butte, where most of the work was on a contract basis, miners earned as much as $9 a shift. Rates for mechanics and hoisting engineers were from $6 to $7 a shift. Accident prevention work received increased attention, especially at the Butte mines. The Anselmo first-aid team of the Anaconda Copper Mining Company won the international championship at the annual contest held at Pittsburgh, Pa.

Neither unemployment nor shortage of labor occurred at any time of the year in the southeast Missouri field. The wage scale remained the same as it has been since early in 1925. Accident prevention and employees' service departments of the companies operating in the district extended their activities, and health conditions of employees were better than at any previous time.

In Colorado, the general labor situation was fairly good. An adequate supply of unskilled labor was at all times available, but there was a scarcity and quite a demand for experienced miners most of the year in the principal mining districts of the state.

Labor conditions in Utah were excellent. There were no labor disturbances, and no changes in the wage scale. An ample supply of labor existed at all the camps throughout the year.

Satisfactory labor conditions prevailed in the mining districts of Nevada, New York, North Carolina, and Tennessee.

Metal Mine Wage Scale in Western States

(Compiled by Colorado Mining Association, Denver, Colo.)

(Revised to Jan. 1, 1928)

Mines	Arizona	California	Idaho	Mont.	Nevada	New Mexico	Utah	S. D.	Colorado		
									Northern Districts	Lake District	San Juan District
Engineer, hoist	$5.78–$6.33	$5.00–$5.50	$5.75	$6.00	$5.00–$6.00	$5.25	$4.50–$6.00	$5.25	$5.00	$4.75–$6.00	$4.75–$5.00
Pipe and track men	5.23– 5.75	....	5.25	5.25	5.25– 6.00	2.50 Mex.	4.75– 5.50	5.50	4.00– 4.50	4.50– 5.00	4.50– 6.00
Timbermen	5.23	4.50	5.50	4.75	5.25– 6.00	4.75	5.00– 5.25	4.75	4.50– 5.00	4.50– 5.00	4.50– 5.00
Machine miner	4.95	4.25– 4.75	5.00	4.75	5.25– 6.00	4.00	5.00– 5.25	4.75	4.50– 5.00	4.75– 5.00	4.50– 5.00
Mucker or trammer	4.40	3.75– 4.25	4.50	4.75	4.50– 5.25	3.25	4.50– 4.75	4.25	4.50	4.00– 4.50	4.00– 4.50
Cage tender	5.23	....	5.25	4.75	5.00– 5.75	4.25	5.00– 5.50	4.25	4.50	4.50– 4.75	4.50
Common labor	4.40	3.50– 4.00	4.25	4.25	4.50– 5.25	4.00	3.75– 4.75	5.50	4.50	4.00– 4.25	3.50– 4.50
Pumpman	5.23	5.25– 5.50	5.25	5.50	5.00– 6.00	5.25	4.50– 6.00	5.00	4.50	4.75– 5.00	4.50
Blacksmith	5.23	6.00	5.75	5.50	5.50– 7.00	5.25	5.50– 5.75	5.25	5.00	5.00– 6.00	5.00– 6.00
Mills											
Mill foreman	....	6.00	6.75	6.00	....	2.50	6.00– 6.50	6.50	5.00	6.00	....
Shift boss	5.75	5.50	5.75	6.00	....	1.80	6.00– 6.50	5.75	5.00	5.00	4.50– 7.00
Tableman	4.40	4.25– 4.50	5.25	6.00	5.00– 6.00	4.00– 4.25	4.25– 4.75	4.00	5.00	4.00– 5.00	3.75– 4.75
Millwright	5.15	....	4.75– 5.75	6.00	5.45– 8.00	5.25	5.50– 5.75	4.75	5.00– 6.00	5.00– 6.00	6.00– 7.00
Electrician	5.23	....	5.75	5.50	6.00– 7.50	5.25	5.50– 5.75	5.50	5.00	5.00– 6.00	5.75– 6.50
Tram men	....	....	5.25	....	....	....	4.75	4.00	4.50	4.00– 4.50	4.00– 4.50
Common labor	2.75	3.50– 4.00	4.25	4.25	4.50– 5.00	2.50 Mex.	3.60– 4.50	3.50	4.00– 4.50	3.75– 4.00	3.50– 4.00
Truck driver	3.75	....	5.00	4.25	....	4.00– 4.25	4.00– 5.25	3.75	4.00– 4.50	4.00– 4.50	....
Machinist	5.23	5.00	5.75	6.00	6.00– 6.50	5.25	5.50– 5.75	5.25	5.00	4.75– 5.00	5.50– 7.00
Crusherman	4.40	....	4.75	....	4.50– 5.25	3.15 Mex.	4.00– 4.75	4.50	4.00– 4.50	4.00– 4.50	4.00– 5.00

ANNUAL REVIEW NUMBER

Mining Dividends Paid in 1926 and 1927

North and South American Companies

Official data supplied by individual companies except when indicated by an asterisk (*) in which case it is from published reports

Company, Metals Mined, and Class of Stock	Situation	Shares Outstanding	Par Value	1926 Per Share	1926 Total	1927 Per Share	1927 Total	Total Paid to End of 1927	Latest Dividend Paid to Dec. 31, 1927 Date	Per Share
*Aluminum Co. of A., pfd	Various	1,472,620	$100	$6.00	$4,418,280	$6.00	$8,835,720	.....	Oct. 1927	$1.50
American Metal	Various	594,836	No	4.00	2,376,003	3.00	1,783,903	.....	Dec., 1927	0.75
American Metal, pfd	Various	50,000	100	7.00	350,000	7.00	350,000	.....	Dec., 1927	1.75
American Smelting & Refining	Various	609,980	100	7.25	4,422,355	8.00	4,879,840	.....	Nov., 1927	2.00
American S. & R., pfd	Various	500,000	100	7.00	3,500,000	7.00	3,500,000	.....	Dec., 1927	1.75
*Anaconda Copper Mining	Various	3,000,000	50	3.00	9,000,000	3.00	9,000,000	$202,958,750	Nov., 1927	0.75
Arizona Commercial, c	Arizona	265,000	5	1.00	265,000	0.75	198,750	2,212,750	July, 1927	0.25
*Bethlehem Steel, pfd	Various	970,000	100	7.00	6,777,660	7.00	6,777,660	.....	Oct., 1927	1.75
Betty O'Neal Mines, s	Nev., Ariz.	465,060	5	0.45	206,381	0.20	93,052	459,478	Nov., 1927	0.05
Bingham Mines Co., s, l	Utah	50,000	10	3.00	150,000	4.00	200,000	1,192,375	Oct., 1927	1.00
Bunker Hill & Sullivan, l, s	Idaho	327,000	10	9.00	2,943,000	9.00	2,943,000	39,768,547	Dec., 1927	0.75
Bunker Hill & Sullivan, pfd	Idaho	6,227	100	9.00	38,710	9.00	50,628		Oct., 1927	2.25
Butte Copper & Zinc, s, l, s, m	Mont.	600,000	5	0.50	300,000	.....	.....	1,500,000	Dec., 1926	0.50
Butte & Superior, z, c	Mont.	290,198	10	2.00	580,395	2.00	580,395	19,116,741	Dec., 1927	0.50
Caledonia Mining, s, l	Idaho	2,605,000	1	.....	.....	0.15	390,750	4,699,056	Dec., 1927	0.05
California Rand, s, g	Calif.	1,280,000	1	0.10	128,000	0.20	256,000	4,518,800	Nov., 1927	0.01
Calumet & Arizona, c, s, g	Ariz.	642,757	10	6.00	3,856,542	6.00	3,856,542	62,018,584	Dec., 1927	1.50
Calumet & Hecla, c	Mich.	2,005,502	25	1.50	3,008,253	2.00	4,011,004	12,033,012	Dec., 1927	0.50
*Cardiff M. & M., s, l	Utah	500,000	1	.....	.....	0.10	50,000	1,075,000	Feb., 1927	0.10
Champion Copper, c	Mich.	100,000	25	5.00	500,000	5.00	500,000	30,070,261	Dec., 1927	5.00
Chief Consolidated, s, l	Utah	1,142,860	1	0.40	455,659	.....	.....	3,540,233	Nov., 1926	0.10
*Cleveland Cliffs Iron	Mich., Minn.	400,000	No	4.00	1,600,000	3.00	1,200,000	.....	Oct., 1927	1.00
*Colorado Fuel & Iron, pfd	Colo., Wyo.	20,000	100	8.00	160,000	8.00	160,000	.....	Nov., 1927	2.00
*Consolidated Lead & Zinc, l, z	Kan., Okla.	200,000	No	2.00	400,000	0.375	75,000	475,000	April, 1927	0.25
*Copper Range, c	Mich.	394,693	25	1.00	394,755	1.00	394,693	29,218,084	May, 1927	1.00
Cresson Consol. Gold	Colo.	1,220,000	1	0.40	488,000	0.40	488,000	11,759,073	Jan., 1928	0.10
Douglas Mining, z, s, l	Idaho	938,500	1	.....	.....	0.0175	14,936	38,408	July, 1927	0.0175
*Eagle-Picher Lead, l, z	Okla.	1,000,000	20	1.60	1,200,000	1.60	1,200,000	.....	Dec., 1927	0.40
*Eagle-Picher Lead, Pfd	Okla.	8,513	100	6.00	51,186	6.00	51,078	.....	Oct., 1927	1.50
*Engels Copper	Calif.	2,877,563	1	0.075	215,817	.....	.....	1,285,972	Aug., 1926	0.005
Fanny Rawlings, c, s, g	Colo.	995,229	1	0.005	4,976	0.005	4,976	55,000	July, 1927	0.005
*Federal Mng. & Smg., s, l, z	Ida., Mo., Kan.	50,400	100	.....	.....	10.00	504,000	.....	July, 1927	10.00
*Federal Mng. & Smg., pfd	Ida., Mo., Kan.	80,000	100	21.00	2,520,000	7.00	560,000	.....	Dec., 1927	1.75
Freeport Texas, su	Texas	729,844	No	.....	.....	4.25	3,101,837	.....	Nov., 1927	1.50
General Development	Various	120,000	25	1.00	120,000	1.00	120,000	.....	Nov., 1927	0.25
Gladstone Mountain, l	Wash.	1,321,890	0.10	0.08	105,751	0.03	39,657	198,283	June, 1927	0.05
Golden Cycle, g	Colo.	1,500,000	1	0.13	195,000	0.16	240,000	10,698,300	Dec., 1927	0.16
Granite Gold	Colo.	1,600,500	1	.....	.....	0.03	48,015	418,500	April, 1927	0.03
*Great Northern Iron Ore	Minn.	1,500,000	No	1.50	2,250,000	1.50	2,250,000	59,250,000	Dec., 1927	0.75
Hecla Mining Co., l, s	Idaho	1,000,000	0.25	2.00	2,000,000	1.00	1,000,000	17,105,000	Dec., 1927	1.00
Homestake Mining, g	So. Dak.	251,160	100	7.00	1,758,120	7.00	1,758,120	52,343,164	Dec., 1927	0.50
*Horn Silver Mines, l, z	Utah	400,000	1	0.03	12,000	.....	.....	.....	Oct., 1926	0.03
*Inland Steel Co	Minn.	1,182,799	No	2.625	3,104,846	2.50	2,956,998	.....	Dec., 1927	0.625
*Inland Steel Co., pfd	Minn.	100,000	100	7.00	700,000	7.00	700,000	.....	Oct., 1927	1.75
Inspiration Consol. Copper	Ariz.	1,181,967	20	2.00	2,363,934	0.75	886,475	45,786,011	May, 1927	0.25
Iron Cap Copper, pfd	Ariz.	18,681	10	0.45	6,981	0.60	11,208	1,078,378	Nov., 1927	0.15
Isle Royale Copper	Mich.	150,000	25	1.00	150,000	1.00	150,000	2,850,000	Oct., 1927	0.50
Jardine Mining, g, a	Mont.	2,184,380	1	0.005	10,922	.....	.....	32,766	Jan., 1926	0.005
*Kennecott Copper	Alaska	4,498,418	No	4.00	17,898,691	5.00	22,492,090	128,767,574	Oct., 1927	1.25
*Keystone Mining, l, s	Utah	900,000	1	0.075	67,500	.....	.....	135,000	Feb., 1926	0.075
Magma Copper Co	Ariz.	408,155	No	3.00	1,224,465	3.00	1,224,465	4,765,162	Oct., 1927	0.75
*Mammoth Mining, l, c, s, g	Utah	395,814	0.10	.....	.....	0.60	237,488	3,138,127	Dec., 1926	0.25
Miami Copper	Ariz.	747,116	5	1.125	840,505	1.50	1,120,674	31,822,643	Nov., 1927	0.375
Mohawk Mining, c	Mich.	115,000	25	5.00	575,000	5.00	575,000	11,900,000	Dec., 1927	2.00
*Mother Lode Coalition, c, s	Alaska	2,500,000	No	0.75	1,875,000	0.50	1,250,000	11,875,000	Dec., 1927	0.25
National Lead Co	Mo., Okla.	309,831	100	8.00	1,652,432	5.75	1,574,803		Dec., 1927	1.25
National Lead Co., pfd. A	Mo., Okla.	243,626	100	7.00	1,705,732	7.00	1,705,732	77,304,235	Dec., 1927	1.75
National Lead Co., pfd. B	Mo., Okla.	103,277	100	.....	.....	3.00	309,717		Nov., 1927	1.75
*Nevada Consol. Copper	Nevada	3,721,763	No	1.125	3,917,826	1.50	5,582,644	51,186,307	Dec., 1927	0.375
New Cornelia Copper	Ariz.	1,800,000	5	1.60	2,880,000	2.00	3,600,000	14,130,000	Nov., 1927	0.50
*New Jersey Zinc	Various	490,816	100	12.00	5,889,792	12.00	5,889,792	.....	Dec., 1927	2.00
Newmont Mining, h	Various	452,760	10	2.40	1,032,000	3.20	1,435,896	3,026,496	Oct., 1927	1.00
Nichols Copper Company, pfd	N. Y.	22,956	100	7.00	160,692	7.00	160,989	.....	Oct., 1927	1.75
*Night Hawk Leasing, c	Ariz.	100,000	.....	1.00	100,000	0.40	40,000	.....	Dec., 1927	0.40
Ohio Copper	Utah	3,019,900	1	0.03	86,454	.....	.....	376,088	Sept., 1926	0.03
*Park-Utah Consolidated, s, l, z	Utah	2,093,500	1	0.60	1,256,100	0.75	1,570,125	3,136,500	Oct., 1927	0.20
*Phelps Dodge Corporation, c	Various	500,000	100	5.00	2,500,000	6.00	3,000,000	112,046,527	Oct., 1927	1.50
Plutus Mining, g, s, l, z, c	Utah	997,145	0.10	0.30	299,864	0.60	599,287	899,150	Dec., 1927	0.20
Portland Gold Mining	Colo.	3,000,000	1	0.06	180,000	0.04	120,000	11,992,080	April, 1927	0.02
*Ray Consolidated Copper	Ariz., N. M.	2,860,192	10	0.25	769,295	.....	.....	.....	April, 1926	0.25
*Republic Iron & Steel	Mich., Ala.	300,000	100	2.00	600,000	4.00	1,200,000	.....	Dec., 1927	1.00
*Republic Iron & Steel, pfd	Mich., Ala.	250,000	100	7.00	1,750,000	7.00	1,750,000	.....	Oct., 1927	1.75
St. Joseph Lead	Various	1,950,438	10	3.00	5,851,253	3.00	5,851,305	.....	Dec., 1927	0.75
St. Mary's Mineral Land Co., c	Mich.	160,000	25	2.00	320,000	2.00	320,000	.....	Mch., 1927	2.00
*Sidney Leasing, z, l, s	Idaho	5,000	5	.....	.....	10.00	50,000	.....	.....	.....
*Sidney Mining, s, l, z	Idaho	1,500,000	1	0.0075	11,250	0.02	30,000	41,250	.....	0.01
Silver King Coalition, s, l	Utah	1,216,100	5	1.10	1,337,710	1.10	1,337,710	21,218,255	Dec., 1927	0.10
*Sloss-Sheffield Iron	Ala.	100,000	100	6.00	600,000	6.00	600,000	.....	Dec., 1927	1.50
*Sloss-Sheffield Iron, pfd	Ala.	67,000	100	7.00	469,000	7.00	469,000	.....	.....	1.75
Sunshine Mining Co., c, s	Idaho	1,500,000	0.10	.....	.....	0.08	120,000	120,000	Dec., 1927	0.02
Tennessee Copper & Chem	Tenn.	794,626	No	1.00	794,618	0.50	397,313	2,898,245	Dec., 1927	0.125
Texas Gulf Sulphur	Texas	2,540,000	No	9.00	7,620,000	4.00	10,160,000	35,877,500	Dec., 1927	1.00
Tintic Standard, s, l	Utah	1,152,915	1	1.70	1,959,956	1.70	1,959,955	9,442,624	Dec., 1927	0.20
*Tomboy Gold Mines	Colo.	310,000	£1	1s.7.2d.	£24,800	.....	.....	£907,618	Aug., 1926	9.6d.
*Tom Reed Gold Mines	Ariz.	921,586	$1	$0.08	$55,295	.....	.....	.....	Dec., 1926	$0.02
Tonopah Mining Co., s, g	Nev.	1,000,000	1	0.15	150,000	$1.00	$150,000	$16,750,000	Oct., 1927	0.075
Tungsten Production	Colo.	3,200,000	1	0.02	64,000	.....	.....	.....	June, 1926	0.02
United Gold Mines	Colo.	4,801,739	0.10	0.02	96,035	0.01	48,017	800,929	Jan., 1927	0.01
United States Sm., Ref., & Mng., l,s	Various	350,115	50	3.50	1,228,903	3.50	1,228,902	55,360,432	Oct., 1927	0.875
U. S. Smelting, Ref., & Mng., pfd	Various	486,350	50	3.50	1,702,225	3.50	1,702,225		Oct., 1927	0.875
*U. S. Steel Corp	Various	7,116,235	100	7.00	35,584,545	7.00	46,258,899	713,387,445	Dec., 1927	1.75
*U. S. Steel Corp., pfd	Various	3,603,141	100	7.00	25,220,254	7.00	25,220,254	698,150,292	Nov., 1927	1.75
United Verde Copper	Ariz.	300,000	No	8.00	2,400,000	12.00	3,600,000	74,512,500	Nov., 1927	3.00
United Verde Extension	Ariz.	1,050,000	0.50	3.00	3,150,000	3.00	3,150,000	30,555,000	Nov., 1927	0.75
Utah Apex Mining, l, c, s, g	Utah	528,200	5	1.20	633,840	.....	.....	2,442,925	Oct., 1926	0.25
*Utah Copper Co	Utah	1,624,490	10	5.25	8,528,542	6.00	9,746,940	156,995,381	Dec., 1927	1.50
Vanadium Corp. of America	Various	378,367½	No	3.75	1,414,264	4.00	1,513,468	4,996,540	Dec., 1927	1.00
*Virginia Iron, C. & C., pfd	Va., Ky.	50,000	100	5.00	250,000	5.00	250,000	.....	July, 1927	2.50
Foreign										
Ahumada Lead, l, s	Mex.	1,192,018	1	1.00	1,192,018	0.275	327,805	3,246,999	April, 1927	0.125
Amparo Mining, g, s	Mex.	2,000,000	1	0.08	160,000	0.05	100,000	5,192,177	Nov., 1927	0.01
*Aramayo Mines, s, t, b, c	Bolivia	840,000	25 Sw. fr.	5 fr.	4,200,000fr.	2½fr.	2,100,000fr.	.....	Nov., 1927	1½fr.
*Asbestos Corp	Que.	200,000	No	$1.50	$45,000	.....	.....	.....	Jan., 1926	$1.50
*Asbestos Corp., pfd	Que.	74,561	$100	5.00	320,964	$7.00	$521,927	.....	Oct., 1927	$1.75
*Belmont Surf. Inlet, g	B. C.	2,500,000	1	0.175	437,500	.....	.....	.....	Dec., 1926	0.025
*Camp Bird, pfd., g, s	Colo.	649,625	£1	8s.6d.	£276,091	9.6d.	£25,985	£2,478,462	Jan., 1927	9.6d.

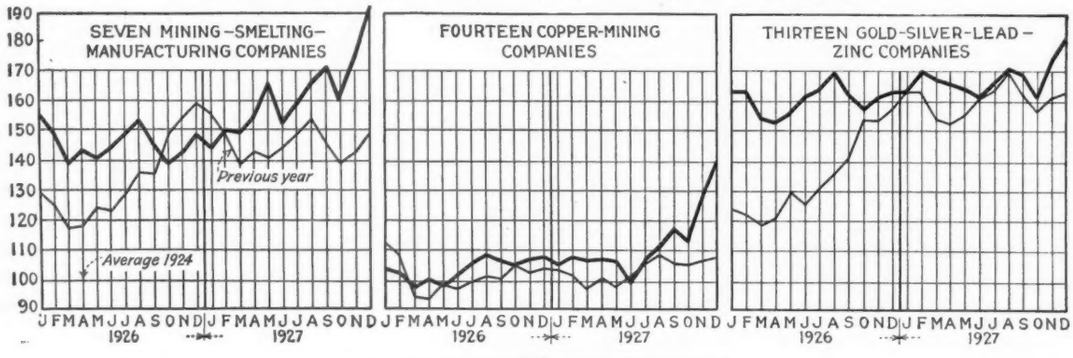
g.—gold; s.—silver; l.—lead; c.—copper; z.—zinc; m.—manganese; a.—arsenic; t.—tin; b.—bismuth; n.—nickel; su.—sulphur; h.—holding company.

Mining Dividends Paid in 1926 and 1927—Continued

Cerro de Pasco Copper, c, s	Peru	1,122,842	No	$5.00	$5,614,210	$4.00	$4,491,368	.....	Nov., 1927	$1.00
Chile Copper Company	Chile	4,415,497	$25	2.50	10,978,326	2.60	11,023,645	$54,866,408	Dec., 1927	0.62
Consolidated M. & S., c, l, z, s	B. C.	508,557	25	9.50	4,817,430	12.50	6,354,862	19,867,688	July, 1927	6.25
*Dome Mines, g	Ont.	953,334	No	2.00	1,905,668	1.25	1,191,666	12,023,764	Nov., 1927	0.25
*Erupcion Mining, l, s	Mex.	1,250,000	1	0.40	500,000	0.325	406,250	2,812,500	Oct., 1927	0.075
Frontino & Bolivia, g	Colombia	140,000	£1	9d.	£5,250	2s.	£14,000	.....	July, 1927	1s.
*Frontino & Bolivia, pfd	Colombia	25,390	£1	2s.	£2,339	2s.	£2,339	.....	July, 1927	1s.
Granby Consolidated, c	B. C.	446,603	$100	.....	.....	$1.00	$432,262	$10,771,720	July, 1927	$1.00
*Hollinger Consol. Gold	Ont.	4,920,000	5	$1.18	$5,805,600	1.30	6,396,000	36,962,400	Dec., 1927	0.10
Howe Sound Co., c, l, s	Mex., B. C.	496,038	No	3.00	1,488,114	4.00	1,984,152	5,258,001	Oct., 1927	1.00
*International Nickel, n, c	Ont.	1,673,384	25	....	3,346,768	2.00	3,346,768	.....	Dec., 1927	0.50
*International Nickel, pfd	Ont.	89,126	100	6.00	534,756	6.00	534,756	.....	Nov., 1927	1.50
*Keeley Silver Mines	Ont.	2,000,000	1	0.24	480,000	0.20	400,000	2,160,000	Sept., 1927	0.08
*Kerr Lake Mines, s	Ont.	600,000	4	0.25	150,000	0.06	36,000	10,371,000	April, 1927	0.86
*Lake Shore Mines, g	Ont.	2,000,000	1	0.50	1,000,000	0.70	1,400,000	4,020,000	Dec., 1927	0.20
Lucky-Tiger Combination, g	Mex.	715,337	10	1.05	751,104	0.67	479,280	12,591,386	Dec., 1927	0.12
*McIntyre-Porcupine, g	Ont.	798,000	5	1.00	798,000	1.00	798,000	6,803,408	Dec., 1927	0.25
*Mexico Mines of El Oro, g, s	Mex.	210,000	£1	2s.3d.	£23,625	....	.....	.....	Dec., 1926	9d.
*Mining Corp. of Canada, s	Ont.	1,660,050	$5	$0.25	$415,013	$0.25	$415,012	$6,536,406	July, 1927	$0.125
*Mond Nickel Co., c, n	Ont	900,000	£1	2s.6d.	£112,500	2s.6d.	£112,500	.....	.....	1s.6d.
*Mond Nickel, pfd., 7% cum	Ont.	500,000	£1	1s.4.8d.	£35,000	1s.4.8d.	£35,000	.....	.....	1s.4.8d.
*Mond Nickel, pfd., 7% "A" cum	Ont	1,250,000	£1	1s.4.8d.	£87,500	1s.4.8d.	£87,500	.....	.....	1s.4.8d.
*Mond Nickel, pfd. non-cumulative	Ont	2,000,000	£1	1s.4.8d.	£140,000	1s.4.8d.	£$140,000	.....	.....	1s.4.8d.
*N. Y. & Honduras Rosario, s, g	Honduras	200,000	$10	$2.00	$400,000	$2.00	$400,000	$7,750,000	Oct., 1927	0.50
Nipissing Mines Co., s	Ont.	1,200,000	5	0.60	720,000	0.45	540,000	28,680,000	Oct., 1927	0.075
*Oroville Dredging Co., g	Colombia	715,636	£1	....	.....	1s.3d.	£44,727	.....	Nov., 1927	1s.3d.
*Patiño Mines & E., t	Bolivia	1,045,100	£20	14s.	£966,221	8s.	£418,040	£2,626,544	Oct., 1927	4s.
Premier Gold Mining, s, g	B. C.	5,000,000	$1	$0.32	$1,600,000	$0.32	$1,600,000	$10,950,000	May, 1927	$0.08
*St. John del Rey, g	Brazil	546,265	£1	.....	.....	9d.	£20,485	.....	May, 1927	9d.
*St. John del Rey, pfd	Brazil	100,000	£1	1s.8d.	£8,333	1s.8d.	£8,333	.....	May, 1927	1s.dd.
*San Francisco Mines, z, s, g	Mexico	1,503,959	10s.	1s.6d.	£112,796	4s.	£300,792	£1,052,626	June, 1927	1s.6d.
*Santa Gertrudis, g, s	Mexico	1,553,400	£1	1s.9d.	£131,488	2s.3d.	£174,757	£1,317,584	July, 1927	1s.6d.
Teck-Hughes Gold Mines	Ont.	4,757,144	$1	$0.10	$474,114	$0.15	$713,572	$1,188,286	Aug., 1927	$0.10
Silversmith Mines, s, l, z	B. C.	1,500,000	0.20	0.08	200,000	.....	.....	$725,000	Oct., 1926	0.02
Vipond Consolidated, g	Ont.	2,250,000	1	.....	.....	0.03	67,500	67,500	April, 1927	0.03
Wright-Hargreaves, g	Ont.	5,500,000	No	0.325	893,750	0.35	1,237,500	3,506,250	Nov., 1927	0.05
*Whitewater Mines, pfd., s, l, z	B. C.	100,000	1	0.25	25,000	.....	.....	675,000	Oct., 1926	0.15

g.—gold; s.—silver; l.—lead; c.—copper; z.—zinc; t.—tin; n.—nickel.

WEIGHTED INDEX OF STOCK MARKET VALUATION OF COMMON SHARES



Mining Directory

Professional Organizations

American Association of Petroleum Geologists, Box 1852, **Tulsa, Okla.**
American Chemical Society, 1709 G St., N. W., Washington, D. C.
American Electrochemical Society, Columbia University, New York.
American Institute of Mining and Metallurgical Engineers, 29 West 39th St., New York.
American Society for Testing Materials, 1315 Spruce St., Philadelphia, Pa.
Australasian Institute of Mining and Metallurgy, 48 Queen St., Melbourne, Victoria, Australia.
Canadian Institute of Mining and Metallurgy, Drummond Building, Montreal, Quebec, Canada.
Chemical, Metallurgical and Mining Society of South Africa, 100 Fox St., Johannesburg, Transvaal, South Africa.
China Institution of Mining and Metallurgy, 13 K' Vei Chia Ch' Ang; Peking, China.
Geological Society of America, Museum of Natural History, Columbus Ave. and 77th St., New York.
Geological Society of London, Burlington House, London W., England.
Geological Society of Washington, U. S. Geological Survey, Washington, D. C.
Institution of Mining and Metallurgy, 225 City Road, London E. C. 1, England.
Mining and Metallurgical Society of America, 2 Rector St., New York.
Society of Chemical Industry, Central House, Finsbury Square, **London**, E. C. 2, England; Pratt Institute, Brooklyn, New York.
Society of Economic Geologists, 42 Broadway, New York.

Mining—Educational Institutions

United States

Alabama—Mine Experiment Station, **University of Alabama, University**, Ala.; J. R. Cudworth, Acting Director.
Alaska—Alaska Agricultural College and **School of Mines, College**, Alaska; C. E. Bunnell, President.
Arizona—College of Mines and Engineering, **University of Arizona**, Tucson, Ariz.; G. M. Butler, Dean.
California—College of Mining, University of California, Berkeley, **Calif.**; F. H. Probert, Dean.
Department of Mining and Metallurgy, **Stanford University, Calif.**; T. J. Hoover, Dean.
Colorado—Colorado School of Mines, Golden, Colo.; M. F. **Coolbaugh**, President.
Connecticut—Department of Mining and Metallurgy, **Yale University**, New Haven, Conn.; C. H. Mathewson, Professor of Metallurgy; Arthur Phillips, assistant professor of metallurgy; R. K. Warner and H. A. Behre, assistant professors of mining.
Idaho—School of Mines, University of Idaho, Moscow, Idaho; **F. A.** Thomson, Dean.
Illinois—Mining Engineering Department, University of Illinois, **Urbana**, Ill.; A. C. Callen, Head.
Iowa—Mining Engineering Department, **Iowa State College, Ames**, Iowa; Prof. A. K. Friedrich, Head.
Kansas—Department of Mining Engineering, **University of Kansas**, Lawrence, Kan.; Prof. C. M. Young, Head.
Kentucky—Department of Mining Engineering; **T. J. Barr**, professor of mining; Department of Metallurgy; C. S. Crouse, professor of metallurgy, University of Kentucky, Lexington, Ky.
Massachusetts—Department of Mining and Metallurgy, Massachusetts Institute of Technology, Cambridge, Mass.; W. Spencer Hutchinson, Head. Department of Mining, Harvard University, Cambridge, Mass. D. H. McLaughlin, Professor of Mining.
Michigan—Michigan College of Mining and Technology, Houghton, Mich.; W. O. Hotchkiss, President.
Minnesota—School of Mines, University of Minnesota, **Minneapolis**, Minn.; W. R. Appleby, Dean.
Missouri—Missouri School of Mines and Metallurgy, **Rolla, Mo.**; Dr. C. H. Fulton, Director.
Montana—Montana State School of Mines, Butte, Mont.; **G. W. Craven**, President.
Nevada—Mackay School of Mines, University of Nevada, **Reno**, Nev.; J. A. Fulton, Director.
Virginia City School of Mines, Virginia City, Nev.; **J. P. Gilbreth**, Director.
New Jersey—School of Engineering, Princeton University, **Princeton**, N. J.; A. M. Greene, Jr., Dean.
New Mexico—New Mexico School of Mines, Socorro, **N. M.**; **E. H. Wells**, President.
New York—School of Mines, Columbia University, **New York, N. Y.**; E. J. Hall, Executive Officer.
Department of Geology, Cornell University, Ithaca, N. Y.; Prof. H. Ries, Head.
North Dakota—College of Engineering and School of Mines, University of North Dakota, Grand Forks, N. D.; E. F. Chandler, Dean.
Ohio—Department of Metallurgical and Mining Engineering, Case School of Applied Science, Cleveland, Ohio; H. M. Boylston, Professor.
Department of Mine Engineering, Ohio State University, Columbus, Ohio; H. E. Nold, Professor.

Oklahoma—College of Engineering, University of Oklahoma, Norman, Okla.; J. H. Felgar, Dean.
Oklahoma School of Mines and Metallurgy, Wilburton, Okla.; E. E. Tourtellotte, President.
Oregon—School of Mines, Oregon State College, Corvallis, Ore.; C. E. Newton, Dean.
Pennsylvania—Department of Mining and Metallurgy, Carnegie Institute of Technology, Schenley Park, Pittsburgh, Pa.; J. Aston, Professor and Head of Department. Department of Mining Engineering, Lehigh University, Bethlehem, Pa.; Prof. H. Eckfeldt, Head. Department of Mining Engineering, Lafayette College, Easton, Pa.; W. B. Plank, Head. School of Mines, University of Pittsburgh, Pa.; E. A. Holbrook, Dean. School of Mines and Metallurgy, Pennsylvania State College, State College, Pa.; D. F. McFarland, acting dean.
South Dakota—South Dakota State School of Mines, Rapid City, S. D.; C. C. O'Harra, President.
Texas—College of Mines and Metallurgy, University of Texas, El Paso, Tex.; C. A. Puckett, Dean.
Utah—Schools of Mines and Engineering, University of Utah, Salt Lake City, Utah; Dr. J. F. Merrill, Director.
Virginia—Department of Mining Engineering, Virginia Polytechnic Institute, Blacksburg, Va.; Prof. O. C. Burkhart, Head.
Washington—College of Mines, University of Washington, Seattle, Wash.; Milnor Roberts, Dean. School of Mines and Geology, State College of Washington, Pullman, Wash.; A. E. Drucker, Dean.
West Virginia—Department of Mining Engineering, West Virginia University, Morgantown, W. Va.; Prof. C. E. Lawall, Head of Mining Engineering Dept. and Director of Mining Extension Dept.
Wisconsin—Department of Mining and Metallurgy, University of Wisconsin, Madison, Wis.; Prof. R. S. McCaffery, Chairman. Wisconsin Mining School, Platteville, Wis.; H. B. Morrow, Director.
Wyoming—Department of Mining Engineering, University of Wyoming, Laramie, Wyo.; Prof. J. R. Guitéras, Head.

Canada

McGill University, Montreal, Que.
Nova Scotia Technical College, Halifax, N. S.
Queen's University, Kingston, Ont.
University of Alberta, Edmonton, Alberta.
University of British Columbia, Vancouver, B. C.
University of Toronto, Queen's Park, Toronto, Ont.

Mexico

Escuela de Ingenieros, Mérida, Yucatan.
Escuela de Ingenieros, Morélia, Michoacan.
Escuela Nacional de Maestros, Zacatecas, Zacatecas.
Colegio de Estato, Guanajuato, Guanajuato.
Ingenieros Agrónimos, Leon, Guanajuato.
Instituto Juarez, Villahermosa, Tabasco.
Universidad Nacional de Mexico, Mexico, D. F.
Instituto Geológico, Mexico, D. F.

U. S. Bureau of Mines

Washington, D. C.—Scott Turner, Director; J. H. Hedges, assistant to the director; J. D. Secrest, chief clerk; C. E. Julihn, chief engineer, Information Division. G. S. Rice, chief mining engineer.

Technologic Branch—O. P. Hood, chief and chief engineer, Mechanical Division; H. H. Hill, chief engineer, Petroleum and Natural Gas Division[1]; R. A. Cattell, chief engineer, Helium Division; D. Harrington, acting chief engineer, Mining Division[2]; A. C. Fieldner, chief engineer, Experiment Stations Division; C. E. Munroe, chief engineer, Explosives Division.

Field Stations—B. M. Bird, supervising engineer, Seattle, Washington; Oliver Bowles, supervising engineer, New Brunswick, N. J.; W. H. Coghill, supervising engineer, Rolla, Mo.; C. F. Cook, supervising engineer, Fort Worth, Tex.; E. D. Gardner, supervising engineer, Tucson, Ariz.; T. L. Joseph, supervising engineer, Minneapolis, Minn.; F. E. Cash, acting supervising engineer, Birmingham-Tuscaloosa, Ala.; E. S. Leaver, supervising engineer, Reno, Nev.; D. A. Lyon, supervising engineer, Salt Lake City, Utah; O. C. Ralston, supervising engineer, Berkeley, Calif.; N. A. C. Smith, supervising engineer, Bartlesville, Okla.; G. St. J. Perrott, superintendent, Pittsburgh, Pa., Station.

Field Offices—C. P. Bowie, supervising engineer, San Francisco, Calif.; A. W. Fahrenwald, supervising engineer, Moscow, Idaho; H. B. Hill, supervising engineer, Dallas, Tex.; J. W. Horne, supervising chemist, Boulder, Colo.; K. B. Nowels, supervising engineer, Laramie, Wyo.; B. D. Stewart, supervising engineer, in charge of Alaskan work; (by courtesy of Geological Survey, Department of the Interior).

Economics Branch—C. P. White, chief and head of Coal Division; F. J. Katz, chief engineer, Mineral Statistics Division; F. L. Hess, chief engineer, Minerals & Metals Division; H. H. Hill, chief engineer, Petroleum Economics Division.

Field Offices—J. P. Dunlop, supervising statistician, Joplin, Missouri; V. C. Heikes, supervising engineer, Salt Lake City, Utah; C. W. Henderson, supervising engineer, Denver, Colo.; J. M. Hill, supervising engineer, San Francisco.

Health and Safety Branch—R. R. Sayers, chief and chief surgeon, Health Division[3]; D. Harrington, chief engineer, Safety Division.

Field Offices—F. E. Cash, supervising engineer, Birmingham, Ala.; E. H. Denny, supervising engineer, Denver, Colo.; J. J. V. Forbes, supervising engineer, Instruction Section, Pittsburgh, Pa.; F. C. Gregory, supervising engineer, Duluth, Minn.; C. A. Herbert, supervising engineer, Vincennes, Ind.; D. J. Parker, supervising engineer, Berkeley, Calif.; F. V. Meriwether, acting assistant surgeon, Picher, Okla.; A. L. Murray, acting assistant surgeon, Salt Lake City, Utah[3]; O. V. N. Linhardt, acting assistant surgeon, Pittsburgh, Pa.

[1]See Ecônomics Branch.
[2]See Health and Safety Branch.
[3]Detailed from the Public Health Service.

U. S. Geological Survey

Director, Dr. G. O. Smith.
Administrative Geologist, J. D. Sears.
Chief Clerk, J. J. Madigan.
Geologic Branch, W. C. Mendenhall.
Alaskan Branch, P. S. Smith.
Topographic Branch, C. H. Birdseye.
Water-Resources Branch, N. C. Grover.
Conservation Branch, Herman Stabler.
Editor, B. H. Lane.

State Geologists and Engineers

Alabama—Dr. W. B. Jones, State Geologist, University of Alabama, University, Ala.
Arizona—Dr. G. M. Butler, Director Arizona Bureau of Mines and State Geologist; University of Arizona, Tucson, Ariz.
Arkansas—G. C. Branner, State Geologist, Little Rock, Ark.; W. N. Wilkes, Commissioner of Mines, Manufactures, and Agriculture, Little Rock, Ark.
California—L. L. Root, State Mineralogist; State Division of Mines and Mining, Ferry Building, San Francisco.
Colorado—Prof. R. D. George, State Geologist, University of Colorado, Boulder, Colo.
Connecticut—Dr. W. E. Britton, Superintendent, State Geological and Natural History Survey, Connecticut Agricultural Experiment Station, New Haven, Conn.
Florida—Herman Gunter, State Geologist, Florida State Geological Survey, Tallahassee, Fla.
Georgia—Prof. S. W. McCallie, State Geologist, Geological Survey of Georgia, Atlanta, Ga.
Idaho—F. A. Thomson, Secretary, Bureau of Mines and Geology, and Dean, School of Mines, Moscow, Idaho.
Illinois—Dr. M. M. Leighton, Chief, State Geological Survey Division, Urbana, Ill.
Indiana—Prof. W. N. Logan, State Geologist, Department of Conservation, Division of Geology, Indianapolis, Ind.
Iowa—Prof. G. F. Kay, Director, Iowa Geological Survey, Iowa City, Iowa.
Kansas—Dr. R. C. Moore, State Geologist, University of Kansas, Lawrence, Kan.
Kentucky—Dr. W. R. Jillson, State Geologist and Director, Kentucky Geological Survey, Frankfort, Ky.
Louisiana—Louisiana Geological Survey, Louisiana State University, Baton Rouge, La.
Maryland—Dr. E. B. Mathews, State Geologist, Maryland Geological Survey, Johns Hopkins University, Baltimore, Md.
Michigan—R. A. Smith, State Geologist, Department of Conservation, Geological Survey Division, Lansing, Mich.
Minnesota—Prof. W. H. Emmons, Director, Minnesota Geological Survey, University of Minnesota, Minneapolis, Minn.
Mississippi—Dr. E. N. Lowe, State Geologist, Mississippi State Geological Survey, University, Miss.
Missouri—H. A. Buehler, State Geologist and Director, Bureau of Geology and Mines, Rolla, Mo.
Montana—Department of Geology, University of Montana, Missoula, Mont.; Prof. J. P. Rowe, Head; C. H. Clapp, Professor of Geology.
Nevada—A. J. Stinson, Inspector of Mines, Carson City, Nev.; State Mining Laboratory, University of Nevada, Reno, Nev.; Prof. W. S. Palmer, Director.
New Jersey—Dr. H. B. Kummel, Director and State Geologist, Department of Conservation and Development, Trenton, N. J.
New Mexico—Prof. R. W. Ellis, State Geologist, University of New Mexico, Albuquerque, N. M.
New York—C. A. Hartnagel, Assistant State Geologist, University of the State of New York, Albany, N. Y.
North Carolina—Wade Phillips, Director, N. C. Department of Conservation and Development, P. O. Box 285, Raleigh, N. C.
North Dakota—Dr. A. G. Leonard, State Geologist, State Geological Survey, University of North Dakota, University, N. D.
Ohio—Prof. J. A. Bownocker, State Geologist, Geological Survey of Ohio, Columbus, Ohio.
Oklahoma—C. N. Gould, Director, Oklahoma Geological Survey, Norman, Okla.
Oregon—Mining Survey Office, School of Mines, Oregon State College, Corvallis, Ore.; Charles E. Newton, Director.
Pennsylvania—Dr. G. H. Ashley, State Geologist, Topographic and Geological Survey, Harrisburg, Pa.
South Carolina—Prof. Stephen Taber, State Geologist, Columbia, S. C.
South Dakota—Dr. E. P. Rothreck, State Geologist, State Geological and Natural History Survey, University of South Dakota, Vermilion, S. D.
Tennessee—W. F. Pond, State Geologist, Tennessee Geological Survey, Nashville, Tenn.
Texas—Dr. J. A. Udden, Director, Bureau of Economic Geology and Technology, University Station, Austin, Tex.
Utah—Prof. William Peterson, State Geologist, Agricultural College of Utah, Logan, Utah.
Vermont—Dr. G. H. Perkins, State Geologist, Dean, University of Vermont, Burlington, Vt.
Virginia—W. A. Nelson, State Geologist, Virginia Geological Survey, University of Virginia, Charlottesville, Va.
Washington—H. E. Culver, Supervisor, Division of Geology, Department of Conservation and Development, and Head, Department of Geology, Washington State College, Pullman, Wash.
West Virginia—Dr. I. C. White, State Geologist, West Virginia Geological Survey, Morgantown, W. Va.
Wisconsin—E. F. Bean, Acting Director, Geological and Natural History Survey, Madison, Wis.
Wyoming—J. G. Marzel, State Geologist; F. B. Taylor, Oil and Gas Inspector, Cheyenne, Wyo.

Trade Associations

General—American Bureau of Metal Statistics, 115 Broadway, New York; American Mining Congress, 841 Munsey Building, Washington, D. C.; Association of Arizona Mining Men, Phoenix, Ariz.; California Metal and Mineral Producers' Association, San Francisco; Chamber of Commerce and Mines, Douglas, Ariz.; Chamber of Mines and Oil, Los Angeles, Calif.; Idaho Mining Association, Mackay, Idaho; Montana Mining Men's Association, Helena, Mont.; National Metal Trades Association, Chicago, Ill.; Nevada Mine Operators' Association, Reno, Nev.; Northwest Mining Association, Spokane, Wash.
Copper—Copper and Brass Research Association, 25 Broadway, New York; Copper Export Association and Copper Institute, 25 Broadway, New York.
Gold—American Gold and Silver Institute, H. N. Lawrie, Managing Director; Munsey Building, Washington, D. C.
Graphite—Plumbago-Graphite Association, 17 State St., New York.
Gypsum—The Gypsum Industries, 844 Rush St., Chicago.
Iron and Steel—American Iron and Steel Institute, 506 Evening Post Building, 75 West St., New York; American Pig Iron Association, Penton Building, Cleveland, Ohio; Association of American Steel Manufacturers, Pittsburgh, Pa.; Lake Superior Iron Ore Association, Cleveland, Ohio.
Limestone, Lime—Indiana Limestone Quarrymen's Association; National Agstone Association, Hartman Building, Columbus, Ohio; National Lime Association, 918 G Street, N.W., Washington, D. C.
Manganese—American Manganese Producers' Association, Metropolitan Bank Building, Washington, D. C.
Petroleum—American Petroleum Institute, 250 Park Ave., New York.
Phosphate Rock—Phosphate Export Association, 301 Produce Exchange Building, New York.
Portland Cement—Portland Cement Association, 347 Madison Ave., New York.
Refractories—American Refractories Institute, 2202 Oliver Building, Pittsburgh, Pa.
Sand and Gravel—National Sand and Gravel Association, Suite 837, Munsey Building, Washington, D. C.
Slate—National Slate Association, W. S. Hays, Secretary; 644 Drexel Building, Philadelphia, Pa.
Zinc—American Zinc Institute, 27 Cedar St., New York.

Important Mining Stocks in 1927

Company	Exch.	High		Low		Last	Net Change	Sales
COPPER								
Anaconda	N. Y.	60⅛	De. 23	41⅛	Ju. 27	58⅛	+10⅛	1,503,000
Arcadian Consol.	B.	3½	De. 21	*20	Jy. 18	3	+2½	75,203
Ariz. Com'l.	B.	10½	Ja. 6	5	Jy. 11	5⅞	−3⅜	97,697
Calaveras	N. C.	2⅝	Ma.	1⅛	Fe.	1⅛	—	138,200
Cal. & Ariz.	N. Y.	123½	De. 21	61½	Ju. 27	119½	+53½	657,800
Cal. & Hecla	B.	24½	De. 21	14½	Jy. 1	22½	+7⅛	160,664
Cerro de Pasco	N. Y.	72⅛	De. 23	58	Ja. 27	69½	+7½	634,700
Chile Copper	N. Y.	44¼	De. 23	33⅛	Ju. 26	42⅛	+7⅜	1,441,800
Con. Copper M.	N. C.	7	De.	2½	Ju.	5⅜	+2⅜	268,300
Copper Range	B.	21⅛	De. 16	11⅞	Ma. 20	19⅜	+5⅛	105,072
Crystal Copper	B. C.	*60	Ju.	*25	Fe.	*50	*+30	.....
East Butte	B.	2⅜	Ja. 4	1⅛	Oc. 14	2	—⅛	43,006
Granby Consol.	N. Y.	45	Ma. 26	31½	Ja. 27	43	+8⅛	580,700
Greene Cananea	N. Y.	151⅛	De. 31	29½	Ja. 27	151⅛	+120	2,657,700
Howe Sound	N. Y.	48⅜	De. 20	34⅜	Jy. 11	45	+5	471,400
Inspiration Con.	N. Y.	25⅛	Ja. 12	12½	Ju. 27	20⅜	−4⅜	362,500
Iron Cap	B. C.	3½	De.	1	Mh.	3	+⅛	.....
Isle Royale	B.	16	De. 21	9	Jy. 13	14⅜	+4	34,303
Kennecott	N. Y.	90⅜	De. 23	60	Fe. 9	85⅞	+23⅞	2,385,100
Magma Copper	N. Y.	58⅛	De. 22	29⅛	Fe. 9	55⅛	+20⅛	699,000
Mason Valley	N. C.	2½	De.	*65	Jy.	1⅛	—	94,600
Miami Copper	N. Y.	20⅛	De. 19	13⅛	Ju. 21	18⅛	+2⅜	330,100
Mohawk	B.	52	De. 15	37	Fe. 18	49⅜	+9⅜	40,351
Mother Lode Cl.	N. Y.	4⅜	Ja. 3	1⅛	Oc. 29	2⅞	−1⅛	388,550
Nevada Con.	N. Y.	20⅜	De. 18	12⅜	Ju. 29	18⅞	+4⅛	1,309,700
New Cornelia	B.	30⅛	De. 27	18⅜	Ju. 24	29	+6⅜	47,683
Noranda	N. C.	28⅜	Oc.	19⅜	Ja.	23⅜	—	466,600
North Butte	B.	3⅜	Ja. 5	*50	Ju. 28	1⅛	−2⅜	98,416
Ohio Copper	N. C.	1⅛	Se.	*40	Mh.	*99	*+54	1,157,400
Old Dominion	B.	15	Ap. 1	9¼	Oc. 27	12⅛	−1⅞	37,664
Phelps Dodge	O. M.	143	Fe.	110	Jy.	130⅜	+⅜	.....
Quincy	B.	19¼	Ap. 22	13⅛	Jy. 13	15	−2⅜	31,658
St. Mary's M. L.	B.	32	De. 19	18⅜	Ju. 28	30	+5	39,441
Seneca Copper	N. Y.	3⅜	Ja. 10	1	Ju. 30	3	+⅛	268,200
Shattuck Denn.	B. C.	*13	No.	*3½	Ja.	*11⅜	....	.....
Tenn. C. & C.	N. Y.	13⅛	Ja. 13	8⅛	Ju. 10	10⅞	—⅛	402,900
U. Verde Ex.	N. C.	34⅜	De.	22⅜	Ja.	25⅛	+1⅛	173,700
Utah Copper	N. Y.	162	De. 24	111	Fe. 11	148½	+35⅛	7,495
Utah M. & T.	B.	2	Fe. 2	*76	Oc. 31	1⅜	+⅜	171,080
Walker Mining	S. L.	1.20	Ja.	*41	No.	*50	*—26	109,770
NICKEL-COPPER								
Inter. Nickel	N. Y.	89½	De. 23	38⅛	Ja. 3	85⅞	+47½	6,936,600
Inter. Nick. pfd.	N. Y.	110	De. 20	103⅜	Ma. 2	110	+5½	2,570
LEAD								
Gladstone Mtn.	S.	*29⅜	Fe.	*11	De.	*11½	*—18¼	.....
National Lead	N. Y.	135	No. 23	95	Ma. 31	129	....	139,300
Nat. Lead pfd. B.	N. Y.	116½	De. 31	104⅞	Ju. 7	116½	....	23,645
Nat. Lead pfd. A.	N. Y.	139½	De. 28	131½	Ju. 2	139	....	9,400
St. Joseph Lead	N. Y.	43⅞	Mh. 4	36	Ma. 23	41⅞	+⅜	177,100
ZINC								
Am. Z., Ld., & S.	N. Y.	10½	Fe. 17	5⅜	Se. 6	6	−2⅜	82,400
Am. Z., L. & S. p.	N. Y.	51½	Fe. 18	35	Oc. 14	40½	−3⅜	123,400
Butte Cop. & Z.	N. Y.	5⅛	Ma. 2	3⅜	Mh. 19	4⅜	0	110,000
Butte & Sup.	N. Y.	11¾	Ja. 7	7⅛	No. 2	9⅜	−1	128,400
Callahan Z. L.	N. Y.	2⅜	Ja. 17	1⅛	Se. 26	1⅜	+⅜	158,900
Con. L. & Z.	St.	17	Ja.	11	No.	14	−2⅜	.....
Eagle-Picher	C.	31	Ma.	22	De.	22½	−5⅜	.....
Eagle-P. pfd.	C.	117½	Au.	116	Ap.	117½	+17⅜	.....
New Jersey Zinc	N. C.	194⅜	Ja.	178	Ja.	184⅜	−9	14,120
United Zinc	N. C.	*55	.....	*55	.....	*55	0	6,000
Yellow Pine	L. A.	*38	Au.	*20	Ja.	*30	*13	.....
GOLD								
Alaska Juneau	N. Y.	2½	Fe. 18	1	Ju. 18	1	—½	82,200
Argonaut	T.	*59	Ma.	*24	Ju.	*33	*—20⅜	.....
Barry Hollinger	T.	1.50	No.	*32	Jy.	1.48	*+32	.....
C. W. Dome L.	T.	*19	Fe.	*4	Au.	*14½	*—3½	.....
Cresson Con. G.	N. C.	2⅛	Ja.	1⅜	No.	2	—⅜	51,900
Dome Mines	N. Y.	14½	De. 15	7	Ju. 30	12⅜	+3	446,000
Golden Cycle	C. S.	1.84	Au. 30	1.59	Ap. 27	1.75	....	117,020
Hollinger Con.	T.	22⅜	Fe.	16.20	Se.	18.05	−2.35	.....
Homestake Min.	N. Y.	75	Oc. 25	60	Ja. 25	70	+8½	11,900
Kirkland Lake	T.	3.05	No.	*84	Mh.	2.71	+1.83	.....
Lake Shore	T.	28½	Oc.	15.40	Ja.	27.05	+11.35	.....
McIntyre-P.	N. Y.	28⅜	Oc. 6	24½	Ma. 14	27⅛	+2⅛	58,800
Portland	C. S.	*58	Ja. 3	*19	De. 15	*21	....	143,900
Rand Mines	N. Y.	46⅜	Ap. 25	39	De. 17	39	—⅛	4,310
Teck-Hughes	T.	12	No.	5.37	Ja.	10.65	+5.20	.....
Tom Reed	La.	*60	Fe.	*25	De.	*33⅛	*—17¼	.....
United Eastern	N. C.	*53	Ja.	*33	Ju.	*45	*—8	83,000
Tough-Oakes	T.	*82	No.	*25	Au.	*75½	*+15½	.....
Vipond Cons.	T.	1.85	Ja.	*49	Oc.	*75⅛	*92¼	.....
Wright-Harg.	T.	13.20	Ma.	5.55	Ja.	6.25	—3.65	.....
GOLD-SILVER								
Carnegie Metals	N. C.	18	De.	11⅛	Oc.	16⅜	+3⅜	16,300
Con Cortez	N. C.	*30	Fe.	*7	Ja.	*18	*+6	120,300
Dolores Esp.	N. C.	*70	Ma.	*35	De.	*50	0	61,100
Premier Gold	N. C.	2 7/16	Au.	1⅜	Ja.	2¼	+⅜	82,400
Tonopah Bel.	N. C.	2 7/16	De.	1	Se.	1	—1⅛	39,500
Tonopah Ext.	N. C.	*55	Ju.	*10	De.	*11	*—7	100,900
Tonopah Mng.	N. C.	3⅜	Ja.	1⅜	Se.	2	—1⅛	25,000
West End Con.	N. C.	*15	Mh.	*4	Oc.	*5	*—4	168,900
Yukon Gold.	B. C.	*83	De.	*25	Mh.	*72	*+30	.....

Company	Exch.	High		Low		Last	Net Change	Sale
SILVER								
Beaver Consol.	T.	2.48	No.	*60	Mh.	2.22	+1.54½	.....
Castle-Trethe	T.	1.45	Ja.	*61	Au.	*76	*—31	.....
Coniagas	T.	5.30	Oc.	3	Ju.	4.70	*+35	.....
Keeley	T.	1.66	Fe.	*70	Se.	*70	*—81	.....
Lorrain Trout L.	T.	*80	Ma.	*25	Mh.	*60	*+10	.....
McKinley-D.-S.	T.	*25½	Se.	*11	Ja.	*20	*+7½	.....
Mining Corp. C.	T.	5.00	No.	2.99	Au.	4.10	*+95	.....
Nipissing	N. C.	10½	Oc.	5⅛	Ju.	5¾	—2¼	263,400
SILVER-LEAD								
Ahumada	N. Y.	6½	Se. 6	2¾	Ju. 2	3½	—1⅜	250,500
Bingham Mines	B.	61¼	De. 15	30	Ja. 3	55⅞	+26⅞	79,882
Bunker H. & S.	N. C.	156	Se.	67½	Ja.	144	+68½	50,100
Cardiff M. & M.	S. L.	1.85	Oc.	*36	Fe.	*85	*+37	134,887
Chief Consol.	S. L.	3.25	Ja.	1.75	No.	3.00	*+10	59,042
Const. M. & M.	S.	*45	Ja.	*14½	No.	*26	*—19	.....
Erupcion	B. C.	1⅛	Ja.	*40	Ju.	*50	*—62½	.....
Eureka Lily	S. L.	1.75	Ap.	*39	Ja.	1.50	+1.11	868,120
Federal M. & S.	N. Y.	187	Ju. 16	60	Fe. 9	150	+62	27,450
Fed. M. & S. pf.	N. Y.	97	Mh. 12	75½	Ja. 28	94	+17	105,300
Hecla Mining	N. C.	18⅛	De.	12⅜	Fe.	17¾	+2⅛	98,700
Highland-S.	S.	*20¼	Ja.	*7	Ma.	*13¼	*—3	.....
Iron King Mng.	S. L.	*59	De.	*23	Ja.	*57	*+27	274,677
Keystone Mng.	S. L.	*45	Fe.	*20	De.	*22	*—8	29,527
Lucky Jim	S.	*33½	No.	*15	Fe.	*28½	*+12½	.....
Lucky Tiger-C.	K. C.	7.90	De. 31	6.00	Ja. 10	7.90	+1.40	38,500
Mammoth Mng.	S. L.	2.70	Ja.	1.50	Jy.	2.05	*—60	26,012
Marsh Mines	S.	3⅜	Mh.	*75	Jy.	1⅜	—⅜	.....
North Lily	S. L.	4.00	Au.	*76	Ja.	3.75	+2.99	152,217
Park Utah	N. Y.	10⅜	De. 15	6	Ja. 3	9⅜	+3⅞	625,800
Plutus Mining	S. L.	2.50	De.	1.40	No.	2.40	*+37½	12,755
San Rafael	S. F.	*33	Ja.	*6	No.	*9	*—19	.....
Silver King Coal	S. L.	11⅛	De.	7.55	Ma.	10⅛	+2.32½	53,700
Silversmith	S.	*40½	Ju.	*13½	Oc.	*20	*—5⅜	.....
Strattons Mines	S.	*55	Ju.	*25	Ja.	*49	*+18	.....
Sunshine M. Co.	S.	1.75	Au.	*37	Ja.	1.20	*+82	.....
Tamarack-Cus.	S.	*77	De.	*21	Ju.	*70	*+31½	.....
Tintic Standard	S. L.	14	Au.	10⅜	Ap.	13⅛	+2⅜	58,398
Utah-Apex	B.	7⅜	Fe. 25	4⅛	Jy. 14	5¼	—⅝	103,188
IRON								
Bethlehem Steel	N. Y.	66½	Se. 8	43½	Ja. 27	58½	+11⅜	3,056,500
Cleveland-Cl.	Cl.	105	Jy.	74	Fe.	105	+30	.....
Colorado F. & I.	N. Y.	96½	Jy. 12	42⅛	Ja. 4	78⅛	+35½	4,863,700
Gt. North. Iron	N. Y.	28⅜	Se. 20	18	Jy. 11	23⅛	+ 3⅜	1,380,300
Inland Steel	N. Y.	62⅛	De. 30	41	Fe. 15	60⅛	+18⅜	341,900
Replogle Steel	N. Y.	13¼	Ja. 10	9½	Ap. 30	12½	+⅜	226,500
Republic I. & S.	N. Y.	75⅛	Ma. 11	53	Oc. 28	60½	+3	460,500
Rep. I.&S. pfd	N. Y.	106	Ma. 26	96⅜	Ja. 3	104	+7⅛	31,800
Sloss-Shef. S. & I.	N. Y.	134½	Ap. 6	110½	No. 9	126	—1	54,900
Sloss-S. S.& I. pf.	N. Y.	110	No. 29	104½	Mh. 22	110	+4¼	5,700
U. S. Steel	N. Y.	160⅛	Se. 16	111⅜	Ja. 28	151⅞	+37⅝	18,935,500
U. S. Steel pfd.	N. Y.	141½	De. 28	129	Ja. 28	140⅞	+10	143,300
Virginia I.C.&C.	N. Y.	51	Ja. 4	36	De. 15	36	—14	6,560
V. I. C. & C. pfd.	N. Y.	76½	Au. 22	62½	De. 27	62½	—18	1,005
DIAMONDS								
DeBeers Con.	N. Y.	32¼	Fe. 14	24	De. 22	24	—8⅛	1,000
ALUMINUM								
Alum. Co. Am.	N. C.	145½	No.	67⅞	Ma.	120	+49	.....
Alum. Co. pfd.	N. C.	106¼	De.	101½	Ma.	105½	+3½	.....
PLATINUM								
S. Am. G. & P.	N. C.	3⅞	Ja.	2¼	De.	2¼	—1⅞	34,000
TIN								
Patiño M. & E.	N. Y.	27½	Fe. 25	18½	Au. 1	23½	—1⅞	239,900
VANADIUM								
Vanadium Corp.	N. Y.	67⅛	De. 20	37	Ja. 20	63¾	+24½	863,400
ASBESTOS								
Asbestos Corp.	M.	39½	Oc.	20	Ma.	35	+11½	.....
Asbestos pfd.	M.	98	Se.	82½	Ja.	95	+9⅝	.....
SULPHUR								
Freeport Texas.	N. Y.	106½	De. 15	34	Ja. 3	103	+69	4,419,040
Texas Gulf	N. Y.	81⅞	Se. 20	49	Ja. 3	77⅞	+28	8,702,500
MINING, SMELTING, REFINING AND GENERAL								
Amer. Metal	N. Y.	48	De. 16	36⅛	No. 3	46½	+3½	229,300
Am. Metal pfd.	N. Y.	113½	De. 23	108	Ja. 6	113½	+1⅜	5,880
Am. Sm. & Ref.	N. Y.	188⅜	De. 21	132⅜	Ja. 25	182½	+39⅛	5,432,300
Am. S. & R. pfd.	N. Y.	133	De. 31	119½	Ma. 16	133	+12½	53,910
Consol M. & S.	M.	274½	De.	215½	Ja.	266	+14	.....
Newmont Mng.	N. C.	139½	De.	67	Ja.	138⅜	+65⅜	449,100
U.S.S.R. & M.	N. Y.	48⅞	De. 6	33⅜	Ja. 13	44⅜	+8⅜	232,300
U.S.S.R.&M.pfd.	N. Y.	54	De. 31	45⅝	Ja. 18	54	+6½	28,900

* Cents; N. Y., New York Stock Exchange; N. C., New York Curb Market; B., Boston Stock Exchange; B. C., Boston Curb; O. M., open market; S. L., Salt Lake; S., Spokane; St., St. Louis; C., Cincinnati; L. A., Los Angeles; S. F., San Francisco; K. C., Kansas City; M., Montreal; T., Standard Stock Exchange, Toronto; C. S., Colorado Springs.

The Market Report

Quiet Week in Non-Ferrous Metals, With Easier Prices

New York, Jan. 18, 1928—Consumers of non-ferrous metals appear to be waiting for "something to turn up," judging from the comparatively small volume of sales during the week ending today. None of the markets is dead, but the tonnage sold has been below the average. Except for New York lead, prices are quoted a little lower all along the line so far as domestic business is concerned. In London there has been practically no change in price levels, except that tin has declined. Platinum has been advanced from $72 per ounce to $85, at which it is fairly active. Quicksilver in New York has declined several dollars recently as a consequence of selling pressure in Europe.

Daily Prices of Metals

Jan.	Copper	Tin		Lead		Zinc
	Electrolytic, N. Y.	99 Per Cent	Straits	N. Y.	St. L.	St. L.
12	13.775@13.825	55.375	55.75	6.50	6.25@6.30	5.625
13	13.775@13.80	54.75	55.375	6.50	6.25@6.30	5.625@5.65
14	13.775@13.80	55.00	55.50	6.50	6.25@6.30	5.625
16	13.775@13.80	54.625	54.875	6.50	6.25@6.30	5.625
17	13.775@13.80	53.50	54.25	6.50	6.25@6.30	5.625
18	13.775	54.25	54.50	6.50	6.25@6.30	5.60
	13.788	54.583	55.042	6.500	6.275	5.623

Average prices for calendar week ending Jan. 14, 1928, are: Copper, 13.835; 99 per cent tin, 55.396; Straits, 56.000; N. Y. lead, 6.500; St. Louis lead, 6.292; zinc, 5.640; and silver, 57.542.

The above quotations are our appraisal of the major markets for domestic consumption based on sales reported by producers and agencies. They are reduced to the basis of cash, New York or St. Louis, as noted. All prices are in cents per pound.

Copper, lead, and zinc quotations are based on sales for both prompt and future deliveries; tin quotations are for prompt delivery only.

In the trade, copper prices usually are quoted on a delivered basis; i.e., delivered at consumer's plant. As delivery and interest charges vary with the destination, the figures shown above are net prices at refineries on the Atlantic seaboard. Delivered prices in New England average 0.225c. per pound above those quoted, and prices at so-called Middle West destinations, 0.325c. above.

Quotations for copper are for ordinary form of wire bars, ingot bars, and cakes. For ingots an extra 0.05c. per pound is charged and there are other extras for other shapes. Cathodes are sold at a discount of 0.13c. per pound.

Quotations for zinc are for ordinary Prime Western brands. Zinc in New York is now quoted at 0.35c. per pound above St. Louis, this being the freight rate between the two points.

Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

London

Jan.	Copper			Tin		Lead		Zinc	
	Standard		Electrolytic	Spot	3M	Spot	3M	Spot	3M
	Spot	3M							
12	61	60 15/16	66 1/2	253 3/8	252 7/8	21 13/16	22 1/4	25 13/16	25 3/4
13	61 9/16	61 3/8	66 1/2	250 1/4	249 5/8	21 11/16	22 1/4	25 3/4	25 3/4
16	61 3/4	61 9/16	66 1/2	249 3/4	248 7/8	21 3/4	22 1/4	25 13/16	25 13/16
17	61 5/8	61 1/2	66 1/2	247	246 1/4	21 11/16	22 1/4	25 15/16	26 1/16
18	61 3/8	61 3/16	66 1/2	246 1/8	245 1/2	21 3/4	22 1/4	26	26

The above table gives the closing quotations on the London Metal Exchange. All prices in pounds sterling per ton of 2,240 lb.

Silver, Gold, and Sterling Exchange

Jan.	Sterling Exchange "Checks"	Silver		Gold London	Jan.	Sterling Exchange "Checks"	Silver		Gold London
		New York	London				New York	London	
12	4.87 1/4	57 5/8	26 1/2	84s11 1/2d	16	4.87 1/4	57 1/4	26 1/4	84s11d
13	4.87 3/8	57 3/4	26 5/16	84s11 1/2d	17	4.87	56 7/8	26 3/16	84s10 1/4d
14	4.87 3/8	57 3/8	26 1/4	.....	18	4.87 1/8	56 7/8	26 3/16	84s11d
					Avg.		57.229		

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of bar silver, 999 fine. London silver quotations are in pence per troy ounce of sterling silver, 925 fine. Sterling quotations represent the demand market in the forenoon. Cables command three-eighths of a cent premium.

Two Copper Markets

A very sharp distinction can be drawn between the position of the important primary producers of copper and the so-called "custom" sellers. Without exception the former have been quoting 14⅛c., and that they have the courage of their convictions is proved by the fact that not a ton was sold by them. Actual sales in moderate volume were made each day until today, during the week, at prices ranging from 14c. to 14.10c., Valley, and at 14.125c. at Middle West destinations. The preponderant tonnage has been placed at 14c. It is understood that offers have been made today that shade this figure, but no transactions are reported.

The situation seems to be that orders are coming in to manufacturers in slow fashion, for the time being, and that they, accordingly, have no disposition to buy freely. Moreover, the tendency of the custom sellers to shade the producers' price encourages buyers to hold off. The producers, on the other hand, by virtue of the data collected through the Copper Institute, feel that they have an accurate picture of the position and that they will ultimately get their price. Business in the foreign market has been fair, about 25,000 tons having been sold thus far this month at 14.50c. c.i.f. Latest statistics from the A.B.M.S. show the daily rate of mine production, in December, as 4,805 tons, the highest rate since the record month of November, 1926.

Weaker Tendency in Lead

The lead market has been disrupted in the week ending today by offerings by a Middle Western dealer at 6½c., St. Louis—5 points less than any producer had theretofore been willing to sell. Apparently this is lead bought some weeks ago in the hope of an advance in price which was not realized. Producers have not been willing to meet this price, though the availability of lead at the lower level has been admitted, and to meet their regular customers halfway a 2½-point concession has been made from the quotations ruling last week, thus bringing producers' prices to 6.275@6.30c. It is said that there was about 1,500 tons of the 6½c. lead to be sold, but it is probable that at least half of it was booked during the week. This lot, of course, is for prompt shipment; February has sold at 6.275@6.30c., and March at 6.30c., St. Louis.

In the East, all sellers continue to quote at the contract price of the American Smelting & Refining Company—6½c., New York, for all deliveries, though lead is said to be available at some other consuming centers in the East at somewhat less than the usual differential from New York prices.

Sales have been rather meager in the last week, with consumers showing no desire to buy except for near-by re-

quirements as a general thing. London has been firm, however, and so long as the foreign market holds up well it seems unlikely to expect domestic producers to weaken much.

Little Change in Zinc

Zinc in fair volume was traded in during the week at 5.625c. A few sales for May-June delivery brought 5.65c. Galvanizers are not active buyers, and many of them feel that a further slight recession in the price is to be expected. Fundamentally, there is little change in the situation. New supplies of electrolytic are about to come on the market from Montana, and this necessarily has an effect on the Prime Western market. Some slight reduction in the mine output in the Joplin-Miami district has been made, but the takings by smelters are less than production, and stocks of concentrate at the plants have increased to 50,000 tons. Producers insist that if 5.50c. should be reached, the smelting capacity will be sharply reduced, even though this process is an exceedingly expensive one. The same claim has been made at higher prices, but the production did not seem to decline.

Tin Drops Further

London tin dropped below £250 on Monday without meeting any resistance and is now lower than for almost three years. In the spring of 1925, £229 was the turning point. Correspondingly low prices have obtained in New York, business having been done as low as 54¼c. yesterday and today. A fair amount of business has been done at the reduced quotations, with both dealers and consumers participating.

Silver Slightly Weaker

During the last week the silver market has continued quiet and inactive with a weak tendency. China has been a small buyer. India still shows little interest at the lower level.

Mexican Dollars (old Mexican pesos): Jan. 12, 44¼c.; 13th and 14th, 44c.; 16th, 43⅞c.; 17th and 18th, 43½c.

Foreign Exchanges Steady

The principal foreign exchanges are quoted at about the same prices as a week ago, closing cable quotations on Thursday, Jan. 17, being as follows: Francs, 3.92⅞c.; lire, 5.28⅛c.; and marks, 23.82c. Canadian dollars, $\frac{3}{16}$ per cent discount.

Other Metals

Quotations cover large wholesale lots unless otherwise specified. London prices are according to latest mail advices.

ALUMINUM—Per lb., 98 or 99 per cent grade, price of leading interest, 24.30c.; outside market, 23.90@24.30c.

ANTIMONY—Per lb., duty paid. New York: Chinese brands, spot business, range for the week 10¼@10⅞c. Forward positions through March about ¼c. higher.

Cookson's "C" grade, spot, 16⅛c. Needle antimony nominally 8c. for lump and 10c. for powdered. White oxide, Chinese, 99 per cent Sb_2O_3, 15½c.

BISMUTH—Per lb., New York, in ton lots, $1.85@$2.10. London, 8s.

IRIDIUM — Per oz., $375@$425 for 98@99 per cent sponge and powder. Strong market; shortage of supply.

NICKEL—Per lb. ingot, 35c.; shot, 36c.; electrolytic, 37c. (99.9 per cent grade) for single lots of spot metal.

PALLADIUM — Per oz., $51@$53. Small lots bring up to $56.

PLATINUM—Official price quoted by the leading interest on small miscellaneous orders for refined metal, per oz., $85, raised from $72 on Jan. 16. Dealers and refiners quote the trade for refined metal, per oz., cash, $82@$83. Market moderately active at higher prices. Whether the strength is of only temporary character remains to be seen.

QUICKSILVER—Per 76-lb. flask, range for week, $122@$124, depending on quantity. Market very quiet. San Francisco wires $128. London, £23; market firm.

RHODIUM—Per oz., $55@$60.

RUTHENIUM—Per oz., $60@$65. Market strong.

Prices of Cadmium, Cobalt, Germanium Oxide, Lithium, Magnesium, Molybdenum, Monel Metal, Osmium, Radium, Selenium, Tantalum, Tellurium, Thallium, Tungsten, and Zirconium are unchanged from the issue of Jan. 7.

Metallic Ores

MANGANESE ORE—Per long ton unit of Mn. c.i.f. North Atlantic ports, minimum 47 per cent Mn; 35@38c. Caucasian, washed, 53@55 per cent, 38.50@40c. Chemical grades unchanged from quotations in the Jan. 7 issue.

TUNGSTEN ORE—Per unit of WO_3, N. Y.; Wolframite, $10.25@$10.50. Western scheelite, $10.50@$10.75. Market dull, but asking price steady.

Chrome, Iron, Tantalum, and Titanium ores are unchanged from quotations in the Jan. 7 issue.

Tri-State Ore Prices Unchanged

Joplin, Mo., Jan. 14, 1928

Blende	Per Ton
High	$39.80
Premium blende, basis 60 per cent zinc	$37.00@ 38.00
Prime Western, basis 60 per cent zinc	36.00
Slimes and fines, 60 per cent zinc	33.00@ 35.00
Average settling price, all zinc	37.39
Galena	
High	$87.50
Basis 80 per cent lead	85.00
Average settling price, all lead	85.45

Shipments for the week: Blende, 9,569; lead, 794 tons. Value, all ores the week, $425,620.

In each week for the last eight weeks, ore buyers have taken approximately 3,000 tons per week less than their requirements, because sellers will not accept the price offered. All of the unsold ore in the bins is held by companies financially able to carry on a protracted fight for a higher price level, and smelter stocks of ore are low. Buyers say they can pay no more on the present metal market, which is true enough. Sellers say, Raise the price.

Platteville, Wis., Jan. 14, 1928

Zinc Blende	Per Ton
Blende, basis 60 per cent zinc	$38.75
Lead Ore	
Lead, basis 80 per cent lead	$85.00

Shipments for the week: Blende, 588 tons; lead, 40 tons. Shipments for the year: Blende, 1,252 tons; lead, 40 tons. Shipments for the week to separating plants, 1,288 tons blende.

Non-Metallic Minerals

Amblygonite, Asbestos, Barytes, Bauxite, Borax, Celestite, Chalk, China Clay, Diatomite, Emery, Feldspar, Fluorspar, Fuller's Earth, Garnet, Gilsonite, Graphite, Greensand, Gypsum, Iron Oxide, Lepidolite, Limestone, Magnesite, Mica, Monazite, Ocher, Phosphate, Potash, Pumice, Pyrites, Quartz Rock Crystal, Silica, Spodumene, Sulphur, Talc, Tripoli, and Zircon are unchanged from prices in the Jan. 7 issue.

Metallic Compounds

ARSENIOUS OXIDE (White Arsenic)—Per lb., 4c. Market slack. London. Cornish white, per long ton, £18¼.

Calcium Molybdate, Copper Sulphate, Sodium Sulphate (Salt Cake), Sodium Nitrate, and Zinc Oxide are unchanged from prices in the Jan. 7 issue.

Ferro-Alloys

FERROMANGANESE—Per long ton, domestic and foreign, f.o.b. furnace or c.i.f. port of entry, $100 quoted for first quarter, 1928. Spiegeleisen, 19@21 per cent, $30@$31 f.o.b. furnace.

FERROTUNGSTEN—Per lb. of W contained, 75@80 per cent, 92@94c. f.o.b. works. Dull.

Ferrocerium, Ferrochrome, Ferromolybdenum, Ferrophosphorus, Ferrosilicon, Ferrotitanium, and Ferrovanadium are unchanged from prices in the Jan. 7 issue.

Metal Products

Rolled copper, lead sheets, nickel silver, yellow metal and zinc sheets are unchanged from price in Jan 7. issue.

Refractories

Chrome Brick, Fireclay Brick, Magnesite Brick, Silica Brick and Zirkite are unchanged from quotations in the Jan. 7 issue.

Iron, Steel, and Coke

Iron—Per gross ton, Valley furnaces, Bessemer, $17.50; basic, $17; No. 2 foundry, $17.25@$17.50.

Steel—Base prices per gross ton, Pittsburgh, billets and slabs, $33; plates, structural shapes, and soft steel bars, per pound, 1.80c.

Coke—Per gross ton, Connellsville furnace, contract, $2.85@$3; spot, $2.75 @$3. Connellsville foundry, contract, $3.75@$4.75; spot, $3.50@$4.75. By-product coke, Ohio and Kentucky, $7.50; Buffalo and Detroit, $9.